Knowledge.

With which is incorporated Hardwicke's Science Gossip, and the Illustrated Scientific News.

A Monthly Record of Science.

Conducted by Wilfred Mark Webb, F.L.S., and E. S. Grew, M.A.

MAY, 1912.

AN IMPROVED TOEPLER PUMP.

By H. J. GRAY.

WHEN working with a Toepler pump in the production of high vacuua, the necessity to refill the mercury reservoir from time to time is a source of inconvenience. To remedy this defect the writer has successfully adopted the device described in the following paragraphs.

The principle will be evident from Figure 183, which represents the essential features of a typical form of Toepler pump. Instead of a single reservoir, two equal mercury-containers are used. These, it will be seen, are connected to the branches of a Y tube fixed in an inverted position. Each branch should be tapped or, as a substitute, strong but easily operated spring clips might be used on the india-rubber connecting tubes. A screw clip would be too troublesome.

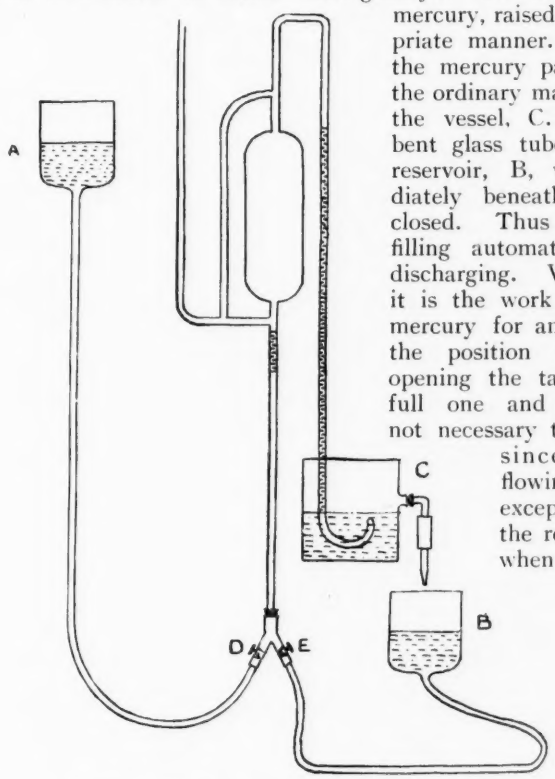

FIGURE 183. An Improved Toepler Pump.

The receptacle, C, containing the end of the eject tube, has a tubulure at the side, into which is fixed a perforated rubber cork, having one end of a bent glass tube passed through it. To the lower end of this is fixed a short rubber tube and glass jet. Let the reservoir, A, be filled with mercury, raised and supported in an appropriate manner. The tap, D, being open, the mercury passes through the pump in the ordinary manner and ultimately reaches the vessel, C. Overflowing through the bent glass tube it falls into the second reservoir, B, which is supported immediately beneath, the tap, E, being kept closed. Thus one reservoir is always filling automatically, while the other is discharging. When A has become empty it is the work of a moment to raise the mercury for another fall. Simply reverse the position of the reservoirs, always opening the tap communicating with the full one and closing the other. It is not necessary to fit a tap to the vessel C, since the mercury is always flowing through the bent tube except for the moment while the reservoirs are being changed, when the short rubber tube may be closed by pressure between the fingers.

A three-way tap may be substituted for the tapped Y-piece with equally good results. It should have a bore of about two millimetres, and may be provided with a mercury trap if considered advisable.

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THE SUNDEW—A BRITISH INSECT-EATING PLANT.

By L. HALFORD DUDLEY BUXTON AND PHILIP J. BARRAUD, F.E.S.

THOSE who are fond of dabbling in old books as well as searching out flowers in the field, will find the subject of our paper thus described by the botanist Ray:—"Sundew, or Rorella, of which the distinguishing marks are: the leaves are fringed all round with reddish bristles, to which little drops, as it were of dew, stick, etc."*

Curiously enough, this keen old observer does not mention the fact to which most people owe their interest in the plant, namely, that it is carnivorous.

It is customary to make the rough generalization —inaccurate often in detail, though true in principle as so many generalizations are—that plants can feed on inorganic substances while animals need organic food. This may be briefly explained as follows:—We are all familiar with the old division of the world into animal, vegetable, and mineral. If we include under mineral everything, such as air and water, which is neither animal nor vegetable, we shall have the matter clear. Organic is animal and vegetable, inorganic is everything else. Animals, then, need organic food; plants can, with some exceptions, do without it, from which it follows that, whereas plants could live without animals, animals could not live without plants.

But if we turn to the Sundew we are immediately confronted with an exception, a plant, which has so far forgotten what is the usual nature of plants, as to feed on meat.

The time has gone past when science was allowed, or indeed expected, to ask "why," but it is our duty to ask "how."

Now it will be noticed that the three British genera of insect-eating plants, *viz.*, *Drosera* (Sundew), *Pinguicula* (Butterwort), and *Utricularia* (Bladderwort) live in marshy districts. It is probable that to live in marshes and stagnant pools is to be in a place where starvation is always a possibility. These plants have found a method of getting out of the difficulty by adopting, partially or entirely, a new diet. But to digest new food materials new methods were necessary, and it is a curious fact that the Sundew manages to digest the animals it captures in a way not unlike that in which we ourselves digest food.

From this we may deduce the interesting fact that a similar problem is solved in a similar way. Such a condition is of special interest at the present day, because of the various evolutionary theories that are being put forward. It is said by some writers that every living thing has in it many possibilities which are not always fulfilled, and that, given the same circumstances, it is possible for living things, though of widely different classes, to solve the same problems in precisely the same way. The Sundew is an instance which might be adduced as a case in point. There are, of course, many objections to the theory.

Let us now consider the Sundew in detail. The photographs here reproduced were all taken from the same leaf at intervals and are enlarged twice natural size.

It will be seen (from Figure 184) that the leaf is furnished with a large number of specialized hairs. Each one bears at the extremity a gland which is very sensitive to the slightest touch, and which secretes a drop of sticky fluid. It is possible that insects when in want of moisture visit the plants in the hope of satisfying their thirst, being attracted by the drops of fluid resembling dewdrops, but when once they have touched the leaf they are usually unable to disentangle their limbs from the sticky substance. The insect in its endeavours to get free is almost certain to touch some of the other hairs, and these help to hold it until it is hopelessly entangled. If we watch very closely, we shall see in a few moments that the hairs, which have been touched, begin to bend inwards towards the middle of the leaf carrying the insect with them. Soon the unfortunate captive is brought into contact with the next row of hairs. These in turn bend, carrying it further inwards, until it is in the middle of the leaf and in contact with the short hairs of the central disc. (See Figures 188–191.)

Then from the last-named some sort of impulse radiates to all the other hairs, and soon the insect is clasped from all sides and enveloped in the secretion. (See Figures 192–195.)

The length of time which this takes varies considerably, from under one hour, to as many as twenty-four or even longer, and depends on the age and consequent vigour of the leaf, the temperature of the atmosphere, and many other circumstances.

An insect, however, generally dies in from fifteen to thirty minutes owing to its breathing tubes (spiracles) becoming clogged with the secretion.

A leaf usually remains closed over a fly for some days, then slowly re-opens, exposing to view the harder parts of the insect, which have not been digested. All secretion then dries up for a time and the undigested parts drop off, or are blown away. Then the leaf again begins to secrete in readiness for another meal.

It is frequently stated that it is not possible to deceive this plant, and that it will take no notice of little pieces of stone or similar objects if they are placed on the hairs. This, however, is not always

* Ros solis seu Rorella, cuius notae folia setis rubentibus circum quaque fimbriata quibus guttulae relut roris adhaerent, and so on.—Ray, "Methodus Plantarum."

FIGURE 184.

FIGURE 185.

FIGURE 186.

FIGURE 187.

Figure 187 is the same as Figure 186, seen from the side.

FIGURE 188.

FIGURE 189.

FIGURE 190.

FIGURE 191.

Figures 189 and 191 are side views of the leaf as it appears in Figures 188 and 190.

FIGURE 192.

FIGURE 193.

FIGURE 194.

FIGURE 195.

Figures 193 and 195 are side views of Figures 192 and 194.

The Leaf of a Sundew (*Drosera*) taken at successive intervals when "feeding" on a Fly. Twice life-size. The Fly was of a species a little smaller than the common House-Fly.

From Photographs by Philip J. Barraud, F.E.S.

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the case, as even minute pieces of stone, paper, wood or glass are sufficient to cause movement, provided they are heavy enough to penetrate the secretion and touch the gland, but the action is often slower and less complete than if meat or insects were used. Raindrops, however, do not seem to cause movement; on the other hand, the leaves are very much affected by the application of a finger.

We have so far been considering the "indoor" side of the Sundew—let us try for a few minutes to search for it out in the sunshine. To show the plant association in which it lives we may give a picture of a favourite hunting ground. This is a marshy piece of ground through which a stream flows, shut in by steeply-rising rocks, in the hollows of which grow oak trees. The essential point for our purpose is the absence of cultivation. Round the marsh there grow many of the sweet-scented plants, mint, and marigolds, "which go to bed with the sun and with him rise weeping," and other flowers of middle summer, as Perdita calls them. There are some low bushes of sweetgale and tufts of heather. To drain off the excessive water, a ditch has been cut through the peat. On the banks of this grow Meadow Sweet, Purple Loosestrife and Butterwort. The marsh itself through which this ditch runs is a vivid green tinged with red from the Bog Moss which fills it. Here the Sundew grows in great abundance, and the tinge of its leaves adds to the colour of the Sphagnum. In one corner, where the marshy character gives place to swamp, the cotton grass becomes prominent, then reeds and horsetails and, finally, on the open water, water lilies float.

A COLOSSAL REINFORCED CONCRETE STATUE.

By FRANK C. PERKINS.

THE accompanying illustrations show the remarkable reinforced concrete Indian statues of Lorado Taft's design, as unveiled in 1911 at Eagle's Nest Bluff, Oregon, Illinois. This colossal statue of the famous Indian chief "Blackhawk," overlooking the Rock River, Illinois, was presented to the people of the state. It measures forty-two feet high with a base of six feet, and was erected on a natural rocky bank two hundred and fifty feet high, overlooking the river. The total height of the concrete statue measures forty-eight feet.

A French reinforced concrete statue was recently erected in Espaly, Loire Department, France, and is also entirely made of reinforced concrete, the pedestal and the figure of St. Joseph together being seventy-two feet. A three-story tower, twenty-five feet in diameter, and 24·4 feet high, forms the base. Within this base are seven columns in a circle, which carry the weight of the statue itself.

The figure, weighing eighty tons, measures forty-eight and a half feet in height, and is composed of a framework of reinforced concrete about which the outside mantle is fitted. The framework in the main is made up of a vertical shaft with a tube at the top which forms the axis for the head. There is a series of nine horizontal platforms in the various sections of the figure which supports the exterior coating of the figure. It is stated that the statue was moulded on the ground and fitted around the framework, all traces of joints being effaced by a proper finish, so that the entire statue seems to be a single structure.

FIGURE 196.
In course of Erection.

FIGURE 197.
The Mould of the Head.

FIGURE 198.
The Head.

FIGURE 199.
The finished Statue.

The Concrete Statue at Eagle's Nest, Bluff, Oregon.

A SIMPLE METHOD OF FINDING THE RADII VECTORES OF A COMET'S ORBIT.

By THOMAS ASHE CREGAN.

To illustrate this method I have taken Comet 1908, *c.*, the positions of which are those given by Professor Kobold in the *Astronomische Nachrichten* for Berlin mean midnight on the 2nd, 4th and 6th October, 1908, the corresponding Greenwich mean time being 11 hours 6 minutes 25 seconds. According to the *English Mechanic*, Vol. LXXXVIII, No. 2274, page 282, these positions are subject to a correction of 90 seconds to add to the Right Ascension and 1′·3 to subtract from the Declination ; they then are as follows :—

	2nd.	4th.	6th.
Comet's R.A. ...	313° 51′ 0″	308° 10′ 30″	303° 34′ 15″
Do. Dec. N. ...	70° 4′ 48″	67° 26′ 42″	64° 30′ 42″

The corresponding places of the sun being—

	2nd.	4th.	6th.
Sun's R.A. ...	188° 34′ 21″	190° 23′ 26″	192° 12′ 32″
Do. Long. ...	189° 20′ 20″	191° 18′ 34″	193° 16′ 52″

Find the earth's orbital motion between the observations, that is, from the 2nd to the 4th and from the 4th to the 6th, and resolve each separately into two components, one a motion almost directly away from the comet, the other a motion in the same direction as that in which the comet, whose motion is retrograde, is moving. Since the comet is at a *finite* distance, its positions are dependent upon our point of view, that is, upon the place of the earth in her orbit. The Declinations must therefore be reduced to the mean Equinoctial and the Right Ascensions corrected for the angular difference between the directions of the first point of Aries as seen from the sun and from the earth, at the instant of observation. Also, with the components of the earth's orbital motion we must reduce the places of the two last observations to that of the first. The corrected and reduced places of the comet then are :—

	2nd.	4th.	6th.
R.A.	305° 16′ 39″	295° 21′ 16″	286° 28′ 30″
Dec.	71° 13′ 48″	68° 51′ 24″	66° 10′ 42″

And these referred to the plane of the Ecliptic give—

	2nd.	4th.	6th.
Geoc. Long. ...	286° 44′ 32″	282° 58′ 42″	279° 2′ 50″
Geoc. Lat. ...	49° 49′ 32″	46° 32′ 47″	43° 14′ 42″

From the foregoing data we next find the value of r at the first observation, for the angle P = 97° 24′ 12″ and of the two sides, PS′ = 40° 10′ 28″ and PS = 90°′, whence SS′ is found to equal 1·57937 in parts of radius, and this is the value of r at *unit distance*. Now, of the three bodies with which this problem deals, *viz.*, sun, earth and comet, since the sun may be considered as stationary, it is evident that if we eliminate the effects of the earth's orbital motion in the interval between the observations from the angle P, we will have the values of P′ and of P″, and a simple proportion will give the values of r′ and r″, assuming for the present that the comet's motion is uniform, therefore—

$$97°\cdot403 : 96°\cdot0694 :: 1\cdot57937 : 1\cdot55745\ r'$$

Also—

$$96°\cdot0694 : 94°\cdot59526 :: 1\cdot55745 : 1\cdot533841\ r''$$

These are the values of r′ and r″, determined from that of r on the supposition that the comet's motion is uniform. This, we know, is not the case. The comet's motion is increasing ; therefore r′ and r″ will both be too great by a quantity equal to the second difference of r, r′ and r″, which must be subtracted from the values just found. We have next to find "c," or the length of the arc of the orbit which the comet appears to describe between the first and last observations. Using the same formula, we have; P = 7° 41′ 42″, PS′ = 40° 10′ 28″, PS = 46° 45′ 18″, which gives S′S in parts of radius as ·142097, to which we must add ·00227 the second difference already found, and we obtain finally :—

$$r = 1\cdot57937,\quad r'' = 1\cdot53157,\quad c = \cdot144367$$

all at *unit distance*, with which to satisfy the equation,

$$2\,t = \frac{365\frac{1}{4}}{12\,\pi}\left\{(r + r'' + c)^{\frac{3}{2}} - (r + r'' - c)^{\frac{3}{2}}\right\}.$$

$2\,t = 8$ days also $\dfrac{365\cdot25}{37\cdot6992} = 9\cdot6885$; therefore,

$\dfrac{8}{9\cdot6885} = \cdot8257$ which is the number that we have to obtain by trial values of r, r″ and c, in order to satisfy the equation. Using figures to the fourth decimal place only, I find that 1·0537 gives ·8255, which satisfies the equation within ·0002 ; therefore the radii vectores of the comet's orbit on the dates computed are :—

	1·6641	1·6389	1·6137
Professor Kobold gives...	1·6642	1·6388	1·6136

To find the corresponding distances of the comet from the earth, or the values of D, D′ and D″. In the triangle CSE, formed by the comet, sun and earth, we have found the side CS, which equals r, and SE = R, is known from the Greenwich date of the observation, we have therefore to find the angle at E. Taking the comet's R.A. at the first observation, *add* to it the angle ♈ SE and reduce the observed declination to the apparent equinoctial of the date, we then have

corrected R.A. = 322° 25′ 21″; reduced Dec. = 71° 49′ 3″,

and these referred to the plane of the Ecliptic give

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the angle at E = 104° 46′ 9″ and the angle at S = 39° 41′ 26″, therefore D = 1·09907 in parts of radius.

While D′ and D″ may be found in like manner, taking care to add to the corrected R.A., the value of the earth's orbital motion in the interval, it is not necessary to undertake this labour, since we only require to know the change in the value of the angle at E. Indeed, since D′ is not involved in the computation of the elements of the orbit, it may be neglected.

To find the angle at E at the second and third observations, we have seen that the difference between P and P′=1° 20′ 2″. Now the angular motion of the earth in the ecliptic in the interval is 1° 58′ 16″; therefore, the difference between these two, subtracted from E at the first observation, gives E′ and we have E′=104° 7′ 55″ and the angle at S′= 39° 36′ 0″ and D′=1·0772. Similarly, the difference between P and P″=2° 48′ 29″ and this subtracted from 3° 56′ 32″, the angular motion of the earth during the interval between the first and last observations, gives a correction of 1° 8′ 3″ by which the the angle E must be reduced to give E″; we have finally, therefore, E″=103° 38′ 6″, and the angle S″=39° 22′ 15″ the resulting value of D″ being 1·0533. The distances of the comet from the earth on the dates computed are, therefore:—

	1·0990	1·0772	1·0533
Professor Kobold gives...	1·099	1·0743	1·0532

Such, in brief, is a description of a method of dealing with this problem, which is concise, easily followed in detail and is independent of any special formulae.

AN IRISH PHARMACOPOEIA.

By M. D. HAVILAND.

IN most places the time-honoured vocation of herbalist or "wise woman" is extinct, but here and there in out of the way corners of the "Emerald Isle" she still plies a flourishing trade.

Some of the rustic remedies have a certain foundation of truth, but more often they are based upon pure superstition. For instance, in cases of jaundice the Dandelion (*Taraxacum officinale*) is justly regarded as a valuable liver tonic; but on the principle that "like draws to like," the virtue is supposed to reside in its yellow colour, and the Yellowwort (*Blackstonia*) and Saffron are used for the same complaint. In County Kilkenny, a horse with colic is treated with soot, a remedy which might possibly give relief in cases of indigestion and flatulence; but what can be said for "a shrew mouse boiled in milk," which I was solemnly assured was a sure remedy for any weakness of the kidneys?

The whooping or *chin* cough, as it is called in Ireland, carries off a large number of peasant children every year, and consequently many remedies are recommended. A favourite medicine for this complaint is donkey's milk, which, no doubt, does work wonders for ricketty children who have been reared upon stewed tea and Indian meal; but superstition has stepped in and declared that the patient must be passed three times over and under the animal, and then seated upon her back. In County Cork an infusion of the Thang-an-uann or Stitchwort (*Stellaria holostea*), sweetened with sugar candy, is also considered efficacious. Snails boiled in milk are thought excellent for consumptive patients; and the Coltsfoot and Marsh-Mallow are justly esteemed as remedies for bronchial affections. In some places the leaves of the Coltsfoot (*Tussilago*) are supposed to "draw" sickness to the house, however.

Along the west coast of Ireland there is a belief that the Common Plantain (*Plantago major*) is good for such ailments as ringworm or parasites in the hair; while another plant of the same family (*Littorella juncea*) is reckoned a sure safeguard against hydrophobia. The properties of the Foxglove (*Digitalis*) are fully recognised by the Celtic herbalists, but Miss Sargent, to whom I am indebted for much interesting information on this subject, tells me that cases of poisoning are not uncommonly traced to its use. A decoction of the stem and leaves in water is a local specific for making the hair grow, and is also rubbed on saddle-galled horses, and on dogs and cats with mange; but if it be applied to any part which the animal can lick, poisoning often results.

In the curing of warts superstition has full play. If you should meet a funeral while suffering from these growths, you should turn and walk three steps with the procession and then bid the warts go to the burial. This is a radical cure. Another plan consists in burying nine blades of Timothy grass; as these decay the warts will disappear. Yet a third remedy practised in County Cork is to anoint the growths with the acrid juice of the *Euphorbia hiberna*, and this is probably the most effectual of the three, as this plant has caustic properties.

Many of these rustic cures owe their efficacy less to the virtues of the "medicine" than to the method of their application. For instance, a remedy for sprains is potato water, but as this is applied as hot as it can be borne, probably the benefit is derived from the hot fomentation; and "crane-oil"—the yellow fat of the heron—is considered good for rheumatism and lumbago, but here again it is most likely the massage in application which gives relief. Yarrow tea is another remedy for rheumatism, and so is a potato carried about in the pocket, but this last is most effectual if begged or stolen. The little bones under the black markings of the haddock—supposed to be the print of St. Peter's fingers—are also carried as charms against toothache. Eel skin is supposed to protect swimmers against cramp—perhaps some properties of the agile fish are thought to linger in its dried epidermis. If anyone has a festered wound caused by a piece of metal, the latter—a nail, a bit of jagged iron, and so on—must be stuck into a raw potato until the sore is healed, otherwise it will mortify. After these, and kindred superstitions, it is interesting to learn that these village physicans are quite aware of the medicinal properties of the Gentian tribe, and recommend the Common Centaury as a tonic for young girls who have outgrown their strength.

No doubt the simple faith with which many of these old cures are used does more to relieve sickness than the medicine itself; but most of them are harmless, if not always very appetizing. Now and then, indeed, one is surprised to find to what extent modern pharmaceutists have been forestalled by these old herbalists of southern Ireland.

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THE ERUPTION OF USA-SAN AND THE FORMATION OF A NEW MOUNTAIN IN JAPAN.

By CHARLES DAVISON, Sc.D., F.G.S.

THE eruption of Usu-san in Japan, which took place in the summer and autumn of 1910, was in no way remarkable for its violence or duration. Nor was it attended by any loss of life, for the police wisely took precautions in time and removed all the inhabitants of the disturbed region beyond the reach of danger. But few eruptions have contributed more to our knowledge of the volcanic mechanism; and the formation of a new mountain, not by the accumulation of ashes, nor by the overflow of lava, but by the actual upheaval of the ground, is a phenomenon that is certainly rare in our annals of volcanic action. Fortunately, the different phases of the eruption were witnessed by an observer of wide experience. Professor Omori, the director of the Seismological Institute in the Imperial University of Tokyo, paid two visits to the district, one during the course of the eruption, and the other three months later, and his first report, which has recently been issued, contains so much that is of interest that a summary of it may be useful.

FIGURE 200.
Map of part of the Island of Hokkaido.

The mountain of Usu lies in the south-western portion of Hokkaido, the northern island of the Japanese empire, a little more than fifty miles to the north of Hakodate, and on the north-east coast of Volcano Bay (Figure 200). In the same district there are three other volcanoes, Makkari-nopli, twenty miles north of Usu-san, Tarumai-san, thirty miles to the north-east, and Komaga-take fifty-four miles to the south. Between these volcanoes there is evidently a close connexion. In 1874, there was a great eruption of Tarumai-san, after which, for nearly thirty-two years, no outburst of any importance took place in Hokkaido. In August, 1905, the recent period of volcanic activity began with an eruption of Komaga-take, which lasted a fortnight. This was followed in January, 1909, by a remarkable eruption of Tarumai-san, which lasted more than three months, during which a lava-dome four hundred and forty feet in height was formed, and in July, 1910, by the eruption of Usu-san, here described.

There appears also to be an intimate relation between the volcanic and seismic phenomena of the district. Common as earthquakes are in certain parts of Japan, they are comparatively infrequent visitors in Hokkaido. In April and May, 1908, however, about a year before the eruption of Tarumai-san, the Island of Rebun, close to the northern point of Hokkaido, was disturbed by numerous earthquakes and earth-sounds, the origin of which was under the sea to the south-west of the island (at A, Figure 200). On June 15th, 1910, or about six weeks before the beginning of the Usu-san eruption, a violent local earthquake, also with a submarine origin (at B, Figure 200), caused some damage near Rumoe. This was followed during the eruption, on September 8th, by another earthquake, somewhat less strong, in the same district. Before these two, the last strong earthquake felt at Rumoe occurred thirty-six years earlier, on February 28th, 1874, shortly after the great eruption of Tarumai-san. The origins of the earthquakes of 1908 and 1910, with those of earlier shocks in 1834 and 1856 (at C and D, Figure 200), lie along a band (indicated by the broken line, Figure 200), which runs nearly north and south, passing through or close to Tarumai-san. Taking into account the rarity of earthquakes in Hokkaido, it is difficult to resist Professor Omori's conclusion that the relation between the earthquakes and eruptions of the island is not accidental.

Usu-san is a comparatively small volcano. It rises from an irregularly circular base, about fourteen square miles in area, bounded on the north by the Lake of Toya. It is a flat plateau-like mass with a central crater, the longer and shorter diameters of which are about two thousand three hundred and one thousand eight hundred and sixty yards in length. The north and south rims of the crater are one thousand seven hundred and seventy one feet above the sea, but on the east and west sides there rise two lava domes (O-Usu and Ko-Usu) to heights of two thousand two hundred and seventy and two thousand two hundred and fourteen feet, respectively. The surface of the Toya lake stands at two hundred and seventy-nine feet above sea level. Before the last eruption, the northern slope of the mountain dipped into the lake at a small angle, so that along the southern coast of the lake there was a band of flat ground three miles long and less than half a mile in width. At the east and west ends of this band are two hills, East Maru-yama

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and Kompira-yama, eight hundred and fifty-three and seven hundred and eighty-seven feet in height respectively. A little more than half a mile north-east of the latter, is a small rounded hill called West Maru-yama, five hundred and ninety feet high.

The last known eruptions of Usu-san took place in the years 1663, 1769, 1822 and 1853. Those of 1663 and 1822 were great eruptions, and, for two or three days before the first outbursts, were preceded by numerous earthquakes and earth-sounds.

The same symptoms heralded the eruption of 1910. In the town of Nishi-Monbets, which lies about five miles to the south of the crater, twenty-five shocks were recorded on July 22nd, one hundred and ten on the following day, three hundred and fifty-one on the 24th, and one hundred and fifty-two up to 10 p.m. on July 25th, when the first explosion occurred. The shocks, as illustrated by the lower curve in Figure 201, reached their greatest frequency twenty-four hours before this eruption. During the immediately preceding twelve hours, only thirty-four were recorded. None of the shocks was of great intensity. Only two of them were strong enough to damage some poorly-built houses, and both disturbed small areas.

The upper curve in Figure 201 represents the variation in barometic pressure at Hakodate, fifty miles south of Usu-san, from July 21st to 29th. It will be noticed that the first premonitory shocks occurred on July 21st when the barometric pressure was a minimum, and that the first volcanic explosion took place on July 25th, when the pressure was a maximum. Roughly, also, the variation in time of earthquake-frequency follows that of the barometric pressure.

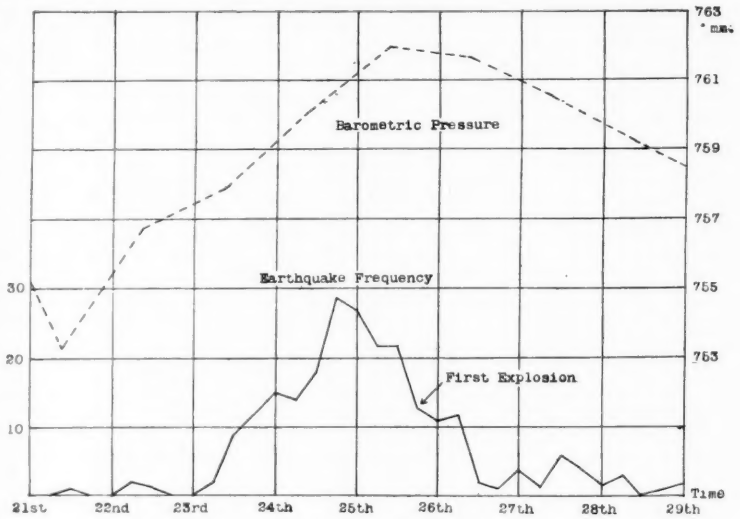

FIGURE 201.

Curves illustrating the number of Earthquake Shocks and the barometric pressure.

The first volcanic outburst was a small explosion at 10 p.m. on July 25th, from the north-west side of Kompira-yama, followed by a second from the west side of the same mountain. These were succeeded by explosions from a number of new craterlets. On August 10th, there were at least twenty-eight craterlets, but explosions from new openings continued to occur until the end of the year. On November 12th, forty-five different craterlets (indicated by the small circles in Figure 202) were counted, the diameters of which varied from one hundred to eight hundred feet. They are situated along three well-defined bands. The most important of these is a curve (A A, Figure 202), rather more than a mile in length, about half a mile from the southern shore of the Toya lake and from six to seven hundred feet above it. It reaches from the western flank of East Maru-yama to the eastern flank of Kompira-yama. Two other bands diverge, one (C) at right angles to the principal band along the axis of West Maru-yama, and the other (B) at a small angle along the axis of Kompira-yama.

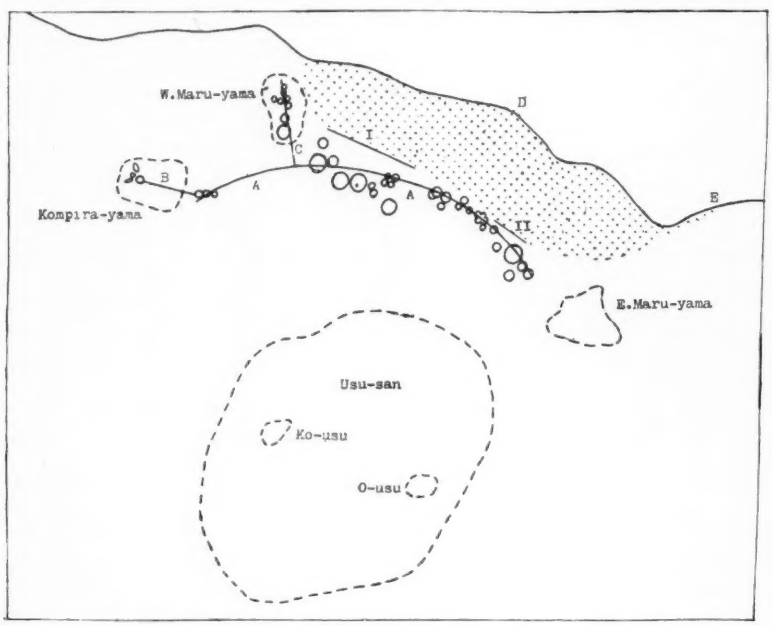

FIGURE 202.

Plan of the Craterlets.

It is important to notice that, from the flat ground forming the southern margin of the Toya lake and the scene of the new mountain, these craterlets were entirely absent.

The first two craterlets, as already noticed, were formed at the west end of the zone of disturbance. The third explosion took place at the east end, then followed three more at the west end, and then another at the east end. After this, they occurred along the zone C through West Maru-yama, and in the centre of the principal band, A A. There was thus an alternation of activity from end to end of the area, terminating by confinement to the central region.

FIGURE 203. Eruptions from three Craterlets.

All of the craterlets were formed in a thick layer of soft earth, and none of the explosions was of great importance. Most of the craterlets quietly ejected ashes and, except when explosions occurred, were unaccompanied by loud detonations or by earth-tremors. There was no outflow of lava from any one of them. Most were in action for a few days or hours only, and then became completely quiescent. A few, however, remained active for several days, and consequently increased in size until they were more than two hundred yards in diameter. When the eruption was at its height, the scene is said to have been magnificent, as smoke-columns could be seen issuing at once from six or seven different craters. Figure 203 shows eruptions taking place simultaneously from three craterlets, that on the left, known as the Kumantsubo craterlet, being one of the most active craters during the whole course of the eruption.

FIGURE 204. The new Mountains seen on the right hand side of the column of smoke.

Some interesting observations on the earthquakes originating from the volcano, especially at the times of the eruptions, were made by Professor Omori. He erected a portable horizontal tromometer and a vertical motion recorder, from July 30th to August 6th, at Nishi-Monbets, five miles from the crater, and from August 6th to 10th, in a school at the foot of East Maru-yama and about three-fifths of a mile from the Kumantsubo craterlet. On the first two days of August, the number of shocks recorded at Nishi-Monbets was about two hundred and ninety, of which ten were sensible to observers in the same town. The number of volcanic earthquakes recorded being about twenty-nine times the number of perceptible shocks, it follows that, if the tromometer had been at work on July 24th, when earthquakes were most frequent, the total number recorded would have been about three thousand eight hundred, or one every twenty-two and a-half seconds. In other words, the ground must have been in a state of almost continual trembling.

A special feature of the records obtained near the Kumantsubo craterlet is the occurrence of well-defined quick unfelt vibrations in addition to the proper volcanic earthquakes. These small vibrations are termed by Professor Omori *micro-tremors*. They were entirely absent at Nishi-Monbets, and rapidly die out with increasing distance from the origin. As a rule, moderate explosions in the Kumantsubo craterlet were not accompanied by marked micro-tremors, but violent explosions from this and other craterlets in the vicinity were accompanied, and often preceded for a few minutes, by well-pronounced micro-tremors. They also occurred when the smoke ejections from the different craterlets were very insignificant or even had completely ceased. It would seem that, if explosions were prevented by some temporary obstruction in a craterlet, the pent-up steam and gases produced in consequence a series of minor earthquakes resulting in the micro-tremors.

On August 6th, Professor Omori discovered accidentally that the eastern part of the south coast of the Toya lake (from D to E, Figure 202) had risen about a yard, causing the lake-margin to retreat about seven yards. At the foot of East Maru-yama, the movement continued, but at a decreasing rate, until, at the end of August, the total rise of the coast was about four feet, and the recession of the coast line about twenty-three yards.

The elevation was not, however, confined to the

shore of the lake. It was still more marked on the northern flank of the volcano, where an area about three thousand yards long, and six hundred and twenty-five yards wide was gradually raised until it became a new mountain. The area, which is represented by dotted shading in Figure 202, is bounded on its southern side by two lines of dislocation (I and II, Figure 202), which are parallel to, and just to the north of, the principal explosive zone, A A. Professor Omori thinks it probable that the elevation of the new mountain began on or about July 21st, when the first earthquakes occurred; but it was only after August 20th that its appearance began to attract general attention. Early in September, the elevation must have been far advanced; for, on the 7th of that month, some houses, built on land which previously sloped at an angle of five degrees, were overthrown in consequence of the increasing inclination. Two months later, the height of the ridge of the new mountain was found by barometric measurements to be six hundred and ninety feet above the level of the lake. As its height before the eruption began was only one hundred and eighty feet above the same level, it follows that the total elevation from the end of July to the beginning of November was five hundred and ten feet, giving an average rate of upheaval of a little over five feet a day. Some time before or after this, the process of elevation must have ceased and an opposite movement set in, for, during April, 1911, the height of the ridge was found to be one hundred and twenty feet less than in the previous November.

The new mountain is shown to the right of the column of smoke in Figure 204, the dome on the left of the figure being O-Usu. The southern face of the new mountain consists of the steep surface of the dislocations (I and II), the height of the slope being about three hundred feet, its inclination varying from thirty to sixty degrees. The other side now slopes directly down towards the lake at an angle of about thirty degrees. It is probable that the slope is continued beneath the lake. If so, this would account for the rise, by more than a foot, which took place in the level of the water surface of the lake in the latter part of July, the rainfall at this time having been insignificant.

Professor Omori regards the formation of the new mountain as the primary or fundamental disturbance, and the earthquakes and volcanic outbursts as secondary or attendant phenomena. The volcanic energy of Usu-san, in his opinion, was manifested by pushing upwards the underground lava-masses beneath the three zones of eruption (A, B, C, Figure 202), the result being the elevation of the new mountain. In consequence of this action, fractures must have been formed below the surface, and the production of such fractures must have caused the premonitory earthquakes, the greatest frequency and intensity of these shocks coinciding with the epoch when the formation of the fractures was at an end. Then followed the explosive stage in the volcanic action, when, on the night of July 25th, the gases and vapours began to escape from the zones so prepared. The elevation of the new mountain was most marked after the epoch of maximum explosive activity, as the continued uplifting of the ground would meet with few obstacles once the actual dislocation had been effected.

AN AEROPLANE INTENDED TO BE NON-CAPSIZABLE.

By FRANK C. PERKINS.

THE design and construction of what is claimed by William P. Bary, of Paterson, New Jersey, to be a non-capsizable aeroplane, is seen in Figure 205. It is held that the object in developing this aeroplane was to maintain lateral balance and, at the same time, furnish a means whereby it would be impossible for the machine ever to acquire an angle in descent from which it would be impossible for the operator to recover with the use of the controls.

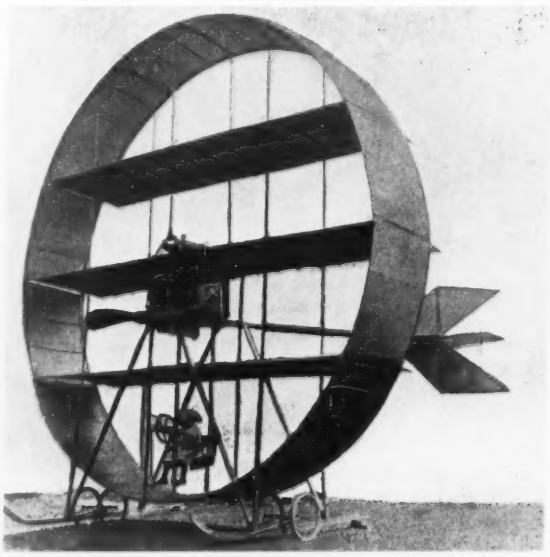

FIGURE 205.

It is held that this has been attempted with a full understanding of the causes of a machine getting beyond the control of the aviator, also the effect of a low centre of gravity in causing oscillation and the dangers attendant. The inventor states that after proving the non-capsizable features in gliding flights and the efficiency in towed flights, a motor was installed which, it is said, has proven only just powerful enough to get the machine off the ground under the most favourable conditions.

KLEPTOMANIA.

By R. M. W.

THERE is nothing the average Englishman prides himself so greatly upon as his common sense. If you ask him he will tell you that he detests humbug in any shape or form, and believes in the grand old custom of calling a spade a spade. Thus, in his terse parlance a man, who shrinks from danger is always a coward, a man whose shifty eyes seem incapable of looking one in the face a "twister," and the individual with a passion for handling other people's property a thief. Such terms as neuropath, kleptomaniac, and the like, are apt to be regarded by him as rather contemptible excuses invented by medical men to cover the sins of their well-to-do patients. Who, for example, has not heard the biting comment "Poor men's sins, rich men's maladies"?

Yet, and this in spite of the fact that such strictures are sometimes justified, there do exist certain true mental diseases, the symptoms of which are easily capable of misconstruction as criminal. And foremost among such is kleptomania, an affliction which compels its unhappy victims to the most persistent, incorrigible and irrational thieving. For the true kleptomaniac can no more refrain from stealing than can the unfortunate possessed by a mania for homicide from murder.

It is the pleasure and excitement of the act of stealing, never, or almost never, the desire of the object stolen, which tempts the kleptomaniac and which distinguishes her (kleptomaniacs are usually women) from the common thief. The following case, which occurred in the writer's practice, illustrates this in a most striking manner.

The individual concerned was a servant girl in a large country house. She came to her employer with a somewhat vaguely-worded character. She was a strong-looking, well-built girl, distinctly handsome and most pleasant and obliging. Her mistress was highly pleased with her, so much so indeed that, on leaving home to go abroad for a few weeks, she entrusted her with the care of the house and with the keys of the store-cupboard and wine-cellar.

Some time after her return she had occasion to visit the latter place. To her amazement she found that several bottles of champagne and at least half a dozen of port were missing. In view of the confidence reposed in the girl this came as a very unpleasant surprise.

Being, however, a singularly fair-minded woman, she decided, even in the face of such strong evidence of guilt, to take no immediate steps to bring the theft home; but instead, and in a way to arouse as little suspicion as possible, made enquiries of certain of the other servants as to the girl's behaviour during her absence. Again, to her surprise, she learned that this had been correct in every particular. There was not even a suggestion of intemperance.

Greatly puzzled, she had almost made up her mind that she must have been mistaken, when one evening she herself encountered the suspect in the act of carrying a bottle of champagne out of the cellar. Taxed with her guilt, the servant broke down completely and confessed everything. She had begun to tipple in her last place, and finding the opportunity to her hand had yielded to what was an overwhelming temptation. She pleaded earnestly for another chance.

After some hesitation this was granted, in the shape of a month's probation under strict surveillance. But long before that time had elapsed, matters were again brought to crisis-point by the reported disappearance of a bottle of methylated spirits. At this juncture the writer was called in, and the facts of the case placed before him.

He had to own himself completely baffled by them. For here was a record of what appeared like steady drinking (champagne, port—at last, when the supply of wine failed, actually methylated spirits) occurring under the sharp eyes of half a dozen fellow servants, not one of whom had so much as suspected anything amiss. On the face of it the thing seemed incredible. Sooner or later such a state of affairs must have aroused comment and suspicion. At the mistress' request he saw the servant alone and questioned her carefully. She admitted everything. She actually seemed anxious to do so. She had taken the wine to her bedroom and drunk it there during the night. By morning all effect had passed off. She assured him that the empty bottles were hidden at the bottom of her trunk.

There seemed to be nothing for it but to recommend immediate dismissal. At the last moment, however, and by the merest chance, another explanation suggested itself—*kleptomania*. Proof of the assertions was demanded in the shape of the empty bottles. Instantly all contrition and humility disappeared. The limp, tearful servant became a hard-eyed defiant woman, daring anybody to interfere with her personal belongings. Faced, however, with the alternative of the police, she at length capitulated.

Then the astounding truth was revealed. In the box were no fewer than eleven bottles, the contents of which were, in each case, absolutely intact. Along with them were a man's waistcoat, recognised as having been stolen from a recent visitor, a razor-strop, a faded blue table-centre, an old linen petticoat, the property of the mistress of the house, and several equally absurd and valueless articles.

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Now, it must be obvious that this collection was not made with a view to subsequent sale, seeing that valuable jewellery and silver plate could have been obtained with just as little, indeed with considerably less, trouble. What then prompted these entirely meaningless thefts? The only possible answer is mania, an insane desire to steal for mere stealing's sake, or in other words, the morbid craving for excitement which is at the bottom of so many motiveless and useless crimes, and which, again and again, has driven apparently sensible men and women to ruin and even suicide. Such diseases as kleptomania belong exclusively to civilisation. They are the product of an age of sensationalism, wherein all things, books, plays, even sermons, are valued according to their capacity to thrill. And, naturally enough, woman, with her delicately-balanced nervous organisation, is the first and chiefest sufferer.

THE NEW ASTRONOMY.

NOVA GEMINORUM.

By PROFESSOR A. W. BICKERTON.

THE new star in Gemini seems to be behaving exactly as the other recent novae from which spectrograms have been obtained. Professor Fowler says that the little spectrum he has obtained by his student's small telescope is as near as possible a replica of Nova Aurigae. By the kind permission of the Astronomer-Royal I was allowed to inspect their spectrograms. The first Greenwich spectrogram shows the blaze bands of hydrogen, each one being bordered on the more refrangible edge by a dark absorption band. The velocity shown by these dark bands seems to me to be less than half of Nova Persei and perhaps slightly greater than Nova Aurigae, something like four hundred miles a second. This was taken on the 15th. A break in the clouds on the 18th enabled the star to be again cleverly captured just long enough to get a very narrow spectrum. The star is rapidly losing light and the shadow bands are much thinner, almost gone, without apparent lessening of displacement.

Surely this evidence must convince astronomers that novae are the explosive third bodies struck from grazing suns. There is not a single minute character of the complex progressive details of their light curves, not one characteristic of all the multiple series of spectrograms of novae, but are observations confirming physical deductions from the third body and published a generation ago in the original papers in the transactions of the New Zealand Institute.

Let us take the light curve. The sudden rise is the explosion of the impact, taking about an hour. The further rise is the expansion due to thermodynamic instability. The descent of the curve is due to the rareness of the gas and the consequent infrequency of molecular encounters that must be associated with excessive expansion. Then comes the oscillation of light; this is due to the periodicity of the pulsation of the pressure of the gaseous nucleus under the influence of the struggle of attraction and inertia. Then, again, notice the extraordinary evidence of the series of spectrograms. The spectrum that shows immediately after impact is continuous, because the light gases are at the centre and have not escaped. Presently they escape and produce black lines. These light gases by taking heat from the heavier acquire enormous velocity. One thousand miles a second was observed in Nova Persei. Hence they soon become vast ensphering shells ever expanding. As the motion is in all directions the line becomes a blaze band. The nucleus although much expanded produces a continuous spectrum, except those isochromatic rays passing to us through the hydrogen gas shell. These suffer reversion and a black line results. This portion of the shell has the greatest resultant speed in our direction, hence is on the extreme edge towards the violet. So we have physical deductions exactly borne out by observations. But the speed of the escaping gas is so enormously above the critical velocity that it will continue steadily to expand. Hence it happens that the portion of the shell in front of the nucleus becomes so rare that absorption ceases and the black lines die out without change of position. Here again deduction and observation agree, as do every subsequent item in the series of spectrograms. Nova Persei was so bright and so well observed that every detail of the character of the bands due to axial extrusion, every difference of the elements and their deduced behaviour, were all confirmed, until the theory of the third body is no longer a mere hypothesis but an absolutely demonstrated deduction. In "The Earth's Beginnings" Sir Robert Ball sums up many observations and concludes absolutely in favour of the idea that novae are undoubtedly the result of grazing impact. The evidence that has accumulated since he wrote is enormously greater than that of which he made use.

FISHERIES AND SHIPPING MUSEUM FOR HULL.

AT Hull, on Saturday afternoon, March 30th, a museum was opened to the public which is probably the only one of its kind in the country. It is devoted entirely to objects connected with the fishing and shipping industries, which play so prominent a part in the city. The museum, which is a large building, and top-lighted, is the gift of Mr. C. Pickering, J.P., a prominent Hull merchant. The exhibits, which have been arranged by the curator, Mr. T. Sheppard, F.G.S., include an exceptionally fine series of harpoons, harpoon guns, flensers, blubber-spades, and other objects connected with the old whaling trade, which commenced at Hull in the sixteenth century, and which may be said to have started the present flourishing oil and fishing industries. On the walls are many valuable paintings of the old Hull whalers in the Arctic, shewing the methods of fishing, as well as paintings and drawings of other Hull ships, from the earliest times to the most recent. There are also dozens of models of ships, illustrating the evolution and growth of the vessels from the old "wooden walls" to modern battleships and liners, all built at Hull. The various phases in the evolution of the old fishing smack into the modern steam trawler are also well shewn by models. There is a valuable set of Esquimaux boats and fishing appliances, brought to Hull during the early part of last century by the old whalers. Amongst more modern fishing appliances are some remarkable models, which were shewn at the Japan-British Exhibition, and were presented to the Hull Corporation by the Japanese Government. These are supplemented by models of Hull fishing nets, and so on, ancient and modern. There are preparations shewing the growth of the prawn, trout, eel, carp, oyster, and so on, and others illustrating the nervous system, blood vessels, skeletons, and so on, of fishes. There is a representative set of skeletons of whales and fishes, large and small, and a large number of mediaeval and later earthenware vessels, and so on, which have been dredged up from the Dogger Bank by the Hull trawlers. As the museum is situated at the entrance to the new park, near the centre of the fishing industry, it bids fair to become popular. This is the third public museum which has been opened at Hull during recent years, while the largest has been increased to twice its size.

THE FACE OF THE SKY FOR JUNE.

By A. C. D. CROMMELIN, B.A., D.Sc., F.R.A.S.

Date.	Sun.		Moon.		Mercury.		Venus.		Mars.		Jupiter.		Uranus.	
	R.A.	Dec.	R.A.	Dec	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
Greenwich Noon.	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.	°
June 4	4 48·3	N.22·4	20 29·6	S. 24·1	3 46·7	N.18·7	4 12·0	N.20·6	8 27·7	N.20·6	16 34·5	S.21·2	20 22·4	S.20·0
,, 9	5 8·9	22·9	0 17·4	N. 0·4	4 27·7	21·4	4 37·8	21·7	8 39·9	19·8	16 31·8	21·1	20 22·0	20·1
,, 14	5 29·6	23·3	4 41·4	N.26·3	5 13·3	23·6	5 4·0	22·7	8 52·1	19·0	16 29·2	21·1	20 21·4	20·1
,, 19	5 50·4	23·4	10 2·1	N.16·3	6 1·2	24·7	5 30·5	23·3	9 4·2	18·1	16 26·7	21·0	20 20·8	20·1
,, 24	6 11·2	23·4	14 8·3	S. 14·5	6 48·3	24·7	5 57·3	23·7	9 16·2	17·2	16 24·4	20·9	20 20·2	20·2
,, 29	6 32·0	N.23·2	18 29·9	S. 28·2	7 32·1	N 23·7	6 24·1	N.23·8	9 28·2	N.16·2	16 22·3	S.20·8	20 19·5	S.20·2

TABLE 15.

Date.	Sun.			Moon.	Mars.						Jupiter.					
	P	B	L	P	P	B	L	T	Q	q	P	B	L_1	L_2	T_1	T_2
Greenwich Noon.	°	°	°	°	°	°	°	h m	°	″	°	°	°	°	h m	h m
June 4	−14·3	−0·1	272·3	−13·4	− 6·4	+14·4	10·2	11 18·1 *m*	102·6	·26	+8·2	−2·9	24·8	342·0	1 29 *m*	10 25 *e*
,, 9	12·3	+0·5	206·1	−21·9	− 4·6	+15·4	321·7	2 37·4 *e*	103·5	·24	8·5	2·9	94·9	14·0	7 15 *e*	11 37 *m*
,, 14	10·2	1·1	139·9	− 6·8	− 2·8	+16·4	273·2	5 56·9 *e*	104·4	·23	8·7	2·9	164·9	45·9	7 30 *m*	0 49 *m*
,, 19	8·0	1·7	73·7	+19·3							9·0	2·9	234·9	77·7	3 25 *e*	7 47 *e*
,, 24	5·8	2·2	7·5	+15·2							9·2	2·9	304·8	109·5	3 40 *m*	8 59 *m*
,, 29	− 3·5	+2·8	301·4	− 3·4							+9·4	−2·9	14·6	141·2	9 27 *e*	6 2 *e*

TABLE 16.

m, *e* denote morning, evening respectively. Greenwich Civil Time (day commencing at midnight) is used. P is the position angle of the body's North Pole measured eastward from the North Point of the disc. B, L are the Helio-(planeto-)graphical latitude and longitude of the centre of the disc (N. latitudes +). In the case of Jupiter there are two systems of longitude, the first for the equatorial region, the second for the temperate zones.

T denotes the time of passage of the zero meridian. Intermediate passages for Mars, Jupiter I and II may be found by applying multiples of $24^h\ 39{\cdot}7^m$, $9^h\ 50{\cdot}4^m$, $9^h\ 55{\cdot}6^m$ respectively.

Q, q for Mars are the position angle and amount of the greatest defect of illumination.

THE SUN reaches his greatest North Declination (Summer Solstice) at $7^h\ 17^m\ e$ on June 21st. During June the semi-diameter diminishes from 15′ 47″·6 to 15′ 45″·4 (practically the minimum). Sunrise $3^h\ 51^m$ on 1st, $3^h\ 49^m$ on 30th; sunset $8^h\ 4^m$ on 1st, $8^h\ 18^m$ on 30th. The chief interest now is in looking for spots in high solar latitudes, heralds of the new cycle.

MERCURY is in superior conjunction with the Sun on June 17th noon. At the beginning of the month he is a morning star, disc $\frac{8}{9}$ illuminated; at the end an evening star, $\frac{8}{9}$ illuminated. The semi-diameter remains nearly steady at 2¾″. Mercury is ½° N. of Saturn June $3^d\ 4^h m$, and ½° N. of Venus June $12^d\ 5^h m$.

VENUS is a morning star, approaching superior conjunction. It is almost fully illuminated, semi-diameter about 5″.

THE MOON is at L. Quar. June $8^d\ 2^h\ 36^m m$, New $15^d\ 6^h\ 24^m m$, F. Quar. $21^d\ 8^h\ 39^m e$, Full $29^d\ 1^h\ 34^m e$. Apogee $4^d\ 1^h\ e$ (semi-diam. 14′ 46″); Perigee $16^d\ 4^h\ e$ (semi-diam. 16′ 36″); Maximum Librations 6° N. June 3^d, 7° E. 11^d, 7° S. 16^d, 7° W. 23^d, 7° N. 30^d. The letters indicate the region of the Moon's limb that is brought into view by libration; E. W. mean the East and West with regard to our sky, not as they would appear to an observer on the Moon. Thus W. is the side towards Mare Crisium.

MARS is getting too far away for profitable work; the physical ephemeris in *The Nautical Almanac* only continues up to the middle of the month. Semi-diameter 2″.

JUPITER is in opposition on June 1st, and is therefore at his best position for the present year; but his south declination is unfavourable for good definition in England. Equatorial

Date.	Star's Name.	Magnitudes.	Disappearance.		Reappearance.	
			Mean Time.	Angle from N. to E.	Mean Time.	Angle from N. to E.
1912.			h m		h m	
June 2 ...	Lacaille 7730	7·0			3 36 *m*	219°
,, 3 ...	BAC 6628	5·9	3 9 *m*	35°	4 11 *m*	297
,, 6 ...	BAC 7608	6·1	1 0 *m*	97	2 7 *m*	215
,, 13 ...	65 Arietis	6 0	2 41 *m*	5	3 5 *m*	309
,, 20 ..	σ Leonis	4·2	10 45 *e*	115	11 39 *e*	303
,, 22 ...	BD—6° 3705	7·0	11 10 *e*	127		
,, 29 ...	BAC—6160	6·4	1 56 *m*	49		

From New to Full disappearances occur at the Dark Limb, from Full to New re-appearances.

TABLE 17. Occultations of stars by the Moon visible at Greenwich.

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semi-diameter 22″, Polar 1¼″ less. The configurations of the satellites at 11ʰ*e* are:—

Day.	West.	East.	Day.	West.	East.
June 1	432 ○ 1		June 16	4312 ○	
,, 2	431 ○ 2		,, 17	43 ○ 1 2	
,, 3	43 ○ 12		,, 18	4½ ○ 3	
,, 4	42 ○ 13		,, 19	42 ⊙ 3	
,, 5	4/3 1 ○ 3		,, 20	4 ○ 123	
,, 6	○ 41⅔		,, 21	41 ⊙ 2	
,, 7	13 ○ 24		,, 22	324 ○ 1	
,, 8	32 ○ 14		,, 23	312 ○ 4	
,, 9	31 ○ 4 2●		,, 24	3 ○ 124	
,, 10	3 ○ 124		,, 25	1 ⊙ 34	
,, 11	2 ○ 34 1●		,, 26	2 ⊙ 34	
,, 12	21 ○ 34		,, 27	○ 1234	
,, 13	○ 12¾		,, 28	1 ○ 324	
,, 14	13 ○4 2		,, 29	32 ○ 14	
,, 15	3¾ ○ 1		,, 30	3/1 ○ 4	

Satellite phenomena visible at Greenwich, 1ᵈ 1ʰ 7ᵐ*m* II. Sh. I., 1ʰ 9ᵐ *m* II. Tr. I., 3ʰ 47ᵐ *m* II. Sh. E., 3ʰ 47ᵐ *m* II. Tr. E.; 2ᵈ 10ʰ 1ᵐ 18ˢ II. Ec. R.; 3ᵈ 1ʰ 53ᵐ*m* I. Oc. D.; 3ᵈ 11ʰ 1ᵐ*e* I. Tr. I., 11ʰ 4ᵐ*e* I. Sh. I.; 4ᵈ 1ʰ 14ᵐ*m* I. Tr. E., 1ʰ 18ᵐ*m* I. Sh. E., 2ʰ 32ᵐ*m* III. Oc. D.; 4ᵈ 8ʰ 19ᵐ*e* I. Oc. D., 10ʰ 34ᵐ 32ˢ*e* I. Ec. R.; 8ᵈ 3ʰ 23ᵐ*m* II. Tr. I.; 9ᵈ 9ʰ 36ᵐ*e* II. Oc. D.; 10ᵈ 0ʰ 37ᵐ 52ˢ *m* II. Ec. R.; 11ᵈ 0ʰ 45ᵐ *m* I. Tr. I., 0ʰ 59ᵐ *m* I. Sh. I., 2ʰ 58ᵐ*m* I. Tr. E., 3ʰ 12ᵐ*m* I. Sh. E.; 11ᵈ 10ʰ 3ᵐ*e* I. Oc. R.; 12ᵈ 0ʰ 28ᵐ 38ˢ*m* I. Ec. R.; 12ᵈ 9ʰ 24ᵐ*e* I. Tr. E., 9ʰ 41ᵐ*e* I. Sh. E.; 14ᵈ 8ʰ 27ᵐ*e* III. Sh. I., 9ʰ 13ᵐ*e* III. Tr. E., 10ʰ 38ᵐ*e* III. Sh. E.; 16ᵈ 11ʰ 52ᵐ*e* II. Oc. D.; 18ᵈ 2ʰ 30ᵐ*m* I. Tr. I., 2ʰ 53ᵐ*m* I. Sh I.; 18ᵈ 9ʰ 23ᵐ*e* II. Tr. E., 10ʰ 14ᵐ*e* II. Sh. E., 11ʰ 47ᵐ*e* I. Oc. D.; 19ᵈ 2ʰ 22ᵐ 50ˢ*m* I. Ec. R.; 19ᵈ 8ʰ 56ᵐ*e* I. Tr. I., 9ʰ 22ᵐ*e* I. Sh. I., 11ʰ 9ᵐ*e* I. Tr. E., 11ʰ 36ᵐ*e* I. Sh. E.; 20ᵈ 8ʰ 51ᵐ 23ˢ*e* I. Ec. R.; 21ᵈ 10ʰ 34ᵐ*e* III. Tr. I.; 22ᵈ 0ʰ 25ᵐ*m* III. Sh. I., 0ʰ 33ᵐ*m* III. Tr. E.; 24ᵈ 2ʰ 9ᵐ*m* II. Oc. D.; 25ᵈ 9ʰ 1ᵐ*e* II. Tr. I., 10ʰ 8ᵐ*e* II. Sh. I., 11ʰ 39ᵐ*e* II. Tr. E.; 26ᵈ 0ʰ 48ᵐ*m* II. Sh. E., 1ʰ 32ᵐ*m* I. Oc. D.; 26ᵈ 10ʰ 41ᵐ*e* I. Tr. I., 11ʰ 17ᵐ*e* I. Sh. I; 27ᵈ 0ʰ 54ᵐ*m* I. Tr. E., 1ʰ 31ᵐ*m* I. Sh. E.; 27ᵈ 10ʰ 45ᵐ 42ˢ*e* I. Ec. R.; 29ᵈ 1ʰ 55ᵐ*m* III. Tr. I.

When phenomena are separated by a comma they are all on the same day.

Eclipse Re-appearances occur high right of the inverted image, taking the direction of the belts as horizontal.

SATURN and NEPTUNE are too near the Sun for convenient observation.

URANUS is coming into a better position, semi-diameter 2″. It is about 2° south of ρ Capricorni.

METEOR SHOWERS (from Mr. Denning's List):—

Date.	Radiant. R.A.	Radiant. Dec.	Remarks.
May 30 to Aug.	333°	+ 28°	Swift, streaks.
May—June...	280	+ 32	Swift.
,, —July...	252	− 21	Slow, trains.
June to Aug.	310	+ 61	Swift, streaks.
,, —Sept.	335	+ 57	Swift.
,, —July...	245	+ 64	Swift.
,, —Aug.	303	+ 24	Swift.

CLUSTERS AND NEBULAE.

Name.	R.A.	Dec.	Remarks.
♅ I. 128	15ʰ 1ᵐ	N 2°·0	Nebula.
♅ I. 215	15 5	N 56 ·1	Nebula.
M. 5	15 13	N 2 ·5	Cluster; near 5 Serpentis.
M. 80	16 11	S 22 ·8	Rich cluster, midway between α, β Scorpii.
M. 4	16 17	S 26 ·3	Large faint cluster.
♅ VI. 40	16 27	S 12 ·8	Large faint cluster.
M. 13	16 38	N 36 ·6	The great cluster in Hercules, one third of way from η to ζ, just visible to naked eye.
Σ 5 N.	16 40	N 24 ·0	Planetary nebula, 8″ diameter.
M. 12	16 42	S 1 ·8	Faint cluster.
♅ IV. 50	16 46	N 47 ·7	Faint planetary nebula.
M. 10	16 52	S 4 ·0	Bright cluster.
M. 62	16 55	S 30 ·0	Cluster.
M. 19	16 56	S 26 ·1	Large cluster.

DOUBLE STARS.—The limits of R.A. are 15ʰ to 17ʰ.

Star.	Right Ascension. h. m.	Declination.	Magnitudes.	Angle. N. to E.	Distance.	Colours, etc.
44 Bootis	15 1	N 48°·0	5, 6	242°	4″	White, grey.
Σ 1919	15 9	N 19 ·5	6, 7	9	24	Yellow, white.
Σ 1926	15 12	N 38 ·5	6, 8	258	1	Yellow, blue.
Σ 1931	15 14	N 10 ·7	6, 7	171	13	White, blue.
Σ 1932	15 15	N 27 ·1	5, 6	333	½	White.
η Coronae Bor.	15 20	N 30 ·6	5, 6	45	1	White.
μ¹ Bootis	15 21	N 37 ·6	6, 7	60	1	Greenish white.
δ Serpentis	15 31	N 10 ·8	3, 4	189	4	Greenish white, purple.
ί Coronae	15 36	N 36 ·9	5, 6	304	6	Greenish white.
γ Coronae	15 39	N 26 ·5	4, 7	112	¾	Yellow, blue.
ξ Scorpii	15 59	S 11 ·2	5, 7	64	7	Yellowish white.
		The brighter star is a close double.				
49 Serpentis	16 9	N 13 ·7	6, 7	336	4	White.
σ Coronae	16 11	N 34 ·0	5, 6	220	5	Yellowish, bluish.
λ Uphiuchi	16 26	N 2 ·1	4, 6	65	1	Yellow, blue.
17 Draconis	16 34	N 53 ·1	5, 6	107	3	White.
ζ Herculis	16 38	N 31 ·8	3, 6	130	1	Yellow, green.
20 Draconis	16 56	N 65 ·1	6, 7	80	⅓	White.

TABLE 18.

FERMENTS AND FERMENTATION.

By DAVID FRASER HARRIS, M.D., B.Sc. (Lond.), D.Sc. (Birmingham).

Lecturer on Physiology, the University, Birmingham.

MANY people would hardly be prepared for the statement that the clotting of milk, the decomposition of a dead body and the digesting of one's dinner are all regarded by physiological chemists as three different examples of the same process, namely fermentation. Yet such is the case: a ferment clots milk, a ferment disintegrates dead matter, and ferments render our food-stuffs capable of absorption. In a vast number of instances where it would have been previously said that such and such an action was "vital," we now say that it is due to a ferment; the action is none the less vital, however, because we have discovered the messenger sent out by the living substance to do its bidding.

Now, while it seems reasonable to speak of the digestion of our food as a vital process, because it goes on inside our living bodies, there seems nothing particularly vital about the clotting of milk to make cheese, or, still less, anything vital about the decomposition of a dead body; yet each of the specific agents whose activity brings about the digestion, the clotting and the disintegration are solely the products of life alone. A ferment is something produced, as far as we at present know, only by living matter for the purpose of effecting certain definite changes in certain substances with which it is to come in contact. The substances thus undergoing change need not necessarily remain within the organ which produced the ferment. For instance, the ferment pepsine of the gastric juice can digest a piece of meat, or fish, or an egg, in a glass vessel kept at the temperature of the blood. This was the discovery of Reaumur (1752), and of Spallanzani (1777), both of whom obtained gastric juice from birds, and showed that the juice was capable of carrying on digestion outside the body, and that the meat was *not* putrified in the process. A young medical man, Stevens, of Edinburgh, also in 1777, published experiments on gastric juice and its activity outside the body. Up to the time of Reaumur, digestion and putrefaction were believed to be processes of exactly the same order chemically. The digestion of meat in a glass vessel is as "vital" as its digestion in the stomach, because as yet no chemist has manufactured pepsine, an organic substance which under certain physical conditions carries out the precise chemical changes which we call digestive. No organic chemist has as yet made pepsine in the sense that he has made sugar, or urea, or indigo—all of which were at one time believed to be able to be made only through the instrumentality of life itself. Pepsine was so named in 1836 by Theodor Schwann.

Now what is it that the ferment has done to the meat whether in the body or in the glass vessel? It has, in the first place, altered its physical state, for the insoluble meat is now a solution filterable and translucent, and, secondly, it has transformed it chemically, for it now consists of highly soluble substances known as peptones; the flesh, or fish, or egg has been "peptonised," made capable of absorption into the blood.

But the ferment has done nothing to the meat which the chemist could not have done without pepsine, had he been given sufficient time. By boiling the meat for long enough under high pressure, and therefore at a high temperature, he could in the end have peptonised, or hydrolysed, the egg-albumen which was what the ferment did in half-an-hour at blood heat, and under ordinary atmospheric pressure.

In a particular case it has been calculated that a ferment effects as much in six hours at 40° C as water at that temperature, without a ferment, would effect in three *years*.

A ferment, then, is a vital agent, although not a vital substance, which accelerates the velocity or rate of change of some physico-chemical process. Pepsine is something manufactured and secreted by the cells of the gastric glands, and no other cells can vicariously manufacture it. We may take it as a type of ferment; it is one of the longest known animal ferments and it can be obtained in a state of comparative purity. To obtain it, the very best method is to chill an animal's pure gastric juice to 0° C, when a fine powdery precipitate falls, closely associated with the hydrochloric acid of the juice.* This powder may be purified, and on being carefully dried will retain its digestive power indefinitely. The full history of the discovery of the various ferments and their characteristics is virtually the history of the establishing of the doctrine of Biogenesis, which is, that life always arises from a pre-existent living being and never from non-living material.

Into this subject we must not at present digress; but to understand the present views of fermentation we should transport ourselves back to the time when fermentation was regarded by the acutest thinkers as a purely chemical or non-vital affair. The controversy was about the cause of "fermentation" *par excellence*, that is alcoholic fermentation, the changing

* This only free acid in the human body was discovered to be a constituent of gastric juice by the English doctor Prout in 1824.

XUM

of sugary liquids into alcohol and carbon dioxide. We speak yet of beer and ale as being "fermented" beverages. In the early years of the nineteenth century the cause of this fermentation was beginning to be attributed to the presence of the yeast-plant or Torula (*Saccharomyces Cerevisiae*). This small fungus had indeed been described by the indefatigable Leeuwenhoek, as early as 1675, in the deposit below a fermenting liquid; no use of this fact was made, however, until about one hundred and sixty years later, when Schwann and Caignard de la Tour, in 1838, demonstrated that these minute bodies were "cells" of vegetable origin and grew abundantly in solutions of sugars. It was natural to connect the presence of these minute fungi with the occurrence of fermentation, but the biologists had to contend against the prestige of the great Swedish chemist Berzelius who held that fermentation was essentially a chemical affair due to "catalysis."

Liebig, in 1848, admitted that the yeast-plant might be a link in the chain of causal antecedents in the fermentation. The essence of his view consisted in this, that fermentation was a disturbance in the molecular structure of the sugar, of such a kind that under the influence of a catalyst the complex molecule fell apart into the simpler ones of succinic acid, alcohol and carbon dioxide. He compared it to the "catalytic" action of metallic platinum black, which causes hydrogen peroxide to be reduced to water and "nascent" hydrogen, in other words, to be chemically broken down. The platinum was a catalyst, it was not changed in the process.

For a time the orthodox view was that of the chemists; fermentation was "catalytic," a view which in 1850 explained nothing; but Berzelius and Liebig had said it was catalytic, and therefore it must be so!

But the biologists on continuing to study the subject found that the more active the fermentation, the more rapidly the plants grew, that the higher the temperature, up to a certain point, the more active was the fermentation, but that boiling the liquid put an end to the whole process. Freezing the liquid arrested without destroying the ferment. All this looked very like life, albeit the living things were invisible to the unaided eye. The conclusion seemed irresistible that as the fermentation was due to the yeast-plant, the plant itself might be regarded as a ferment, a living ferment, an organised or insoluble ferment, to distinguish it from a ferment like pepsine, which seemed to belong to another class non-living, unorganised, soluble. For many years these two species of ferments were recognised. About 1879 the physiological chemist, Kühne of Heidelberg, suggested the name Enzymes or Zymins for the soluble ferments, the secretions of living cells.

The classical experiment of Helmholtz, in 1843, seemed to demonstrate very simply that alcoholic fermentation was due to an insoluble ferment. He placed some boiled grape-juice in a bladder, which he immersed in a vat of fermenting grape-juice; after a certain time the contents of the bladder were found *not* to have fermented, therefore the ferment was not so soluble as to pass through the bladder used. Later it was shewn that the ferment could be excluded by cotton-wool.

Helmholtz, others, and finally Tyndall in this country, made it certain that fermentation was not due to the presence of air or of oxygen, as some of the chemists had thought possible. Fermentation and putrefaction were alike vital, for, as time went on, it appeared that what applied to the former seemed equally to apply to the latter.

Dead matter, it seemed, would not change its physico-chemical state unless ferments now identified as microscopic saprophytes could gain access to it. Putrescible matter boiled did not putresce but remained indefinitely in the ***status quo ante*** until micro-organisms were permitted access to it, when it promptly decomposed. These micro-organisms were organised ferments, some of which needed oxygen (aërobic), some of which did not need oxygen (anaërobic) and some of which could live with or without oxygen (facultative); this classification was due to Pasteur (1857–61).

Dead matter putrefied because it was invaded by organised ferments which broke it down into chemical substances (amides and amino-acids), simpler than the proteins (albumins) of which it was composed at the moment of death. Thus post-mortem putrefaction was directly due to the presence of life; if the air going to putrescible material was previously passed through a red hot tube, so that all micro-organisms were burnt out of it, the material did not putrefy.

Before long, bacteria, rod-like forms, were found to be the *vera causa* of putrefaction; bacteria of other shapes were found to be the cause of many infectious diseases thenceforth called "zymotic," that is, fermentative. Disposal of the dead—vegetable or animal—is therefore the duty of the humblest species of plant life, the organised ferments.

For many years the sharp distinction between the organised and unorganised ferments was maintained by biologists; but in course of time it became apparent that the organised, or insoluble, ferments could, in reality, carry out the chemical changes peculiar to them only by means of something secreted by them through their cellulose cell-walls. Obviously if no interchange of material went on between the protoplasm inside the cell-wall and the sugar outside, then the living plant cell could not influence or alter the state of the sugar in any way whatever, for in histology we do not believe in "action at a distance" If the cell-membrane was absolutely impermeable, then the yeast was exactly as an inert body might be in the sugar.

(To be continued.)

OF THE KNOWLEDGE OF HISTORICAL MEDALS.

By A. M. BROADLEY.

Author of "Dr. Johnson and Mrs. Thrale."

A MEDAL has been described as "a circular piece of metal issued to record or commemorate an event or a person, and embellished with devices and inscriptions representative, symbolical or connected with its particular purpose." This rather vague definition can scarcely be regarded as satisfactory, the shape of a medal not necessarily being circular; for many well-known examples are oval, while a few are octagonal. The most familiar form of medal is that struck by the State as a reward for military or naval service, and worn as a distinctive decoration by the recipient. Our present concern, however, is principally not with medals designed and issued to serve as badges, but with those intended only for commemorative purposes. It is to historical medals that Joseph Addison alludes in his "Dialogue" when he speaks of "Critics in rust." Possibly the fondness of Englishmen for medals is not as great as that of the foreigner, for a modern writer declares that "while we distribute tracts the French distribute medals." From the end of the fourteenth century downwards some of the world's greatest artists have turned their attention to the designing of medals. Amongst the great mediaeval medallists may be mentioned the names of men like Vittore Pisano, Matteo de Pasti, Benvenuto Cellini and Albert Dürer. In the sixteenth and seventeenth century their traditions were perpetuated in France by Primavera, Pilon and Dupré. The English commemorative medal begins with the reign of Elizabeth, although we have portrait medallions of Henry VIII, Edward VI and Queen Mary. The fine English medals of the Commonwealth and the reign of Charles II, were the handiwork of those great engravers, Thomas and Abraham Simon. Rawlins was also employed by Charles II after the Restoration. From the time of William and Mary onwards nearly all the designers of British medals were foreigners. The collecting of war medals is a cult of itself, but for some unaccountable reason the public interest in historical medals has languished, although its votaries were once as numerous and enthusiastic as those of philately are to-day, when the expenditure of the £2,500 necessary to purchase specimens of the penny red and twopenny blue Post Office Mauritius, intrinsically worth the fraction of a farthing, would suffice to secure a fine cabinet of gold and silver medals illustrating English history from the reign of James I down to the coronation of George V, including possibly half a dozen unique examples!

FIGURE 206. The Naval Medal of 1653 for the Battle of Portland, in the collection of Messrs. Spink.

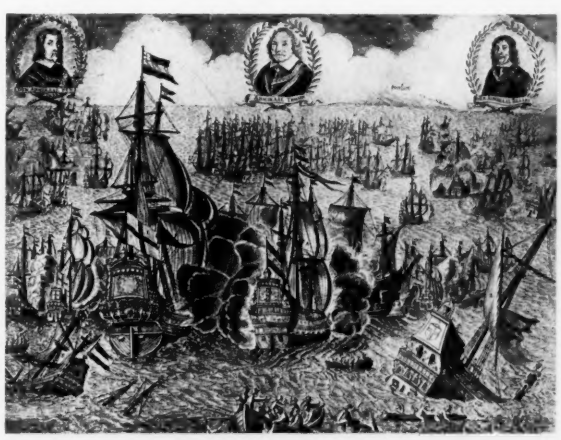

FIGURE 207. A rare Dutch Engraving of the Battle of Portland, February, 1653, in the collection of A. M. Broadley.

There are few more useful aids to history than the monumental work, in two volumes, compiled by the late Edward Hawkins, and entitled "Medallic Illustrations of the History of Great Britain and Ireland to the death of George II." This book was edited by A. W.

FIGURE 208. A Restoration Medal of 1660.

Franks and H. A. Grueber, and printed by order of the Trustees of the British Museum. It is, for obvious reasons, indispensable to every collector of commemorative medals. In my book, "The Royal Miracle," which Mr. Stanley Paul is to publish on May 29th, I hope to give some account of the curious medals and badges worn by the adherents of Charles II between 1649 and the Restoration, many of which after the fateful year 1651 bore the symbol of the royal oak. On January 1st of that year the young King (not yet twenty-one) was crowned at Scone. The gold medal struck on that occasion, which is not illustrated here, is one of the rarest of the English coronation series. Mr. Hawkins thus describes it: "Bust of Charles II, *r*, crowned, hair long, in plain falling collar, ermine robes and collar of the Garter. Legend: "Carolus 2 . D . G . Sco . Ang . Fra & Hib. . Rex . Fi . De . *Cor* . *i* . ia . Scon 1651." *Rev.* Lion rampant, *l.*, holding a thistle in his paw. Legend: "Nemo . me . impune . lacessit." In the British Museum there is a leaden medal, believed to be unique, which commemorates the escape of Charles II from Worcester (September 3rd, 1651), and his six weeks' wanderings between that date and his escape from Shoreham to Fécamp on October 15th of that year. On the obverse is a view of the walls and fortifications of Worcester with defenders; outside, Charles on horseback attended by the four Penderels and Yates, and before him a company of soldiers, above, "Woster." Legend: "God – bles – my – Lord – Wilmot – Lady – Lane – Col – Carter – Capt – Tedersal –" Reverse, sword and olive branch crossed between C. R. Legend: "In – utrumque – paratus." It is unnecessary to say that the names thus displayed on it are the names of the principal actors in the enterprise, and whose sterling loyalty mainly contributed to the escape of the King.

FIGURE 209. The great Gold Medal of 1661, commemorating the restoration of Charles II.

It was only two years later, while Charles was still in exile, that the first historic medal now illustrated was issued by the Commonwealth. It is commemorative in its character, but was given by the Government as a reward to Admiral Blake and the other principal naval officers engaged in the battle of Portland and the war against the Dutch. It was struck in two sizes. The specimen illustrated is of the smaller size, and was granted to captains. On the obverse is an anchor from which is suspended three shields charged with the crosses of St. George and St. Andrew, and the Irish harp. Reverse, ships in action. The larger medal granted to senior officers was surrounded by a wide border representing the bow, stem, mast, flags, drums, and arms taken from the enemy; both are in gold, and the work of the celebrated engraver, Thomas Simon. Blake's own medal was purchased by His Majesty, King William IV.

The fine example from which the reproduction has been made is now in possession of Messrs. Spink and is priced at £300. The medal is shewn conspicuously, together with a vignette view of Portland, below the fine mezzotint portrait of Admiral Blake, by Thomas Preston, after a painting belonging to Mr. J. Ames, now in my possession. Below it are the words:—"*Vindex Commercii.*—Robert Blake, General and Admiral of the Forces of England, etc., Denatus

FIGURE 210. John Roettier's Gold Medal in honour of Giles Strangways, of Melbury, Dorset, executed after the Restoration, by order of Charles II. Only two examples of this Medal are known to exist.

29 Aug., 1659, ætat 59," and the lines:—

Thy name
Was heard in thunder through th' affrighted shores
Of pale Iberia, of submissive Gaul
And Tagus trembling to his utmost source
O ever faithful, vigilant and brave,
Thou bold asserter of Britannia's Fame
Unconquerable Blake.

The battle off Portland was fought on February 18–20th, 1653. The English admirals engaged were Blake, Deane, Lawson, Howett, Monck, Peacock, Martin, Penn, Lane and Bourne. It ended near the Isle of Wight on February 20th, when Blake, reinforced by the arrival of the remainder of the fleet, "re-engaged with great desperation, and after a most valiant fight drove the enemy before him and captured or destroyed eleven ships of war and sixty merchantmen. Fifteen hundred men were killed and seven hundred taken prisoners." Mr. H. Parker, in his "Naval Prints," mentions four small engravings of this engagement, but I have succeeded in discovering a large contemporary Dutch line-engraving measuring fifteen and a quarter inches by twenty-one and a half inches. It is surmounted by portraits of Blake, Penn and Van Tromp, encircled with laurels. In order to avoid possibility of error the rocks in the background are lettered Portland. (See Figure 207.)

FIGURE 211. One of the complete series of six Duke of Monmouth Medals, in the collection of A. M. Broadley.

FIGURE 212. A very rare anti-Jacobite Medal of 1688, ridiculing the birth of the Old Pretender, the legitimacy of whom it calls into question.

Nearly every county has its historic medals, Dorset being particularly

rich in this respect. The large Strangways' gold medal (see Figure 210) does great credit to the ability of John Roettier, its designer. Copies in gold are in possession of Giles Strangways' descendant, the Earl of Ilchester, and the present writer. The legends on it are sufficiently legible. An account of Giles Strangways, and the part he took in helping the fugitive King during his concealment at Trent (Sept.—Oct., 1651) will be found in the "Royal Miracle." This medal, executed after the Restoration, was one of an intended series ordered by Charles II in honour of distinguished sufferers in the royal cause. The design on the reverse of the medal—"the White Tower of London surmounted by the Royal Standard, with the sun bursting from behind a cloud," was personally suggested by the Sovereign. Giles Strangways was born at Melbury in 1615, commanded a regiment of horse in the King's service in the West, was persecuted by the Parliament, heavily fined, and imprisoned in the Tower with his father. Mr. Hawkins omits all mention of his generous behaviour in 1651 and subsequent prosperity. George Bower's medal in honour of the Earl of Shaftesbury (1681) also relates to a Dorset worthy, whose lineal descendant and successor still flourishes in the county and holds high office in the State. The design of reverse bears a strange resemblance to that of the Strangways' medal. In Figure 213 we have a view of London from Southwark; the Tower in the distance, and above, the sun bursting from behind a cloud. Dryden made this medal, struck at the instigation of the popular party, who celebrated Shaftesbury's acquittal November 24th, 1681, with great rejoicings and many bonfires, the subject of his well-known satirical poem, *The Medal*. In describing it he says:

FIGURE 213. George Bower's Silver Medal, struck in 1681 to celebrate the Rejection by the Grand Jury of a Bill for the Indictment against Anthony Ashley, Earl of Shaftesbury, for High Treason. The subject of Dryden's Poem, "The Medal."

FIGURE 214. A Jacobite Medal of the Young Pretender, 1745.

"One side is fill'd with title and with face;
And, lest the King should want a regal place,
On the reverse a Tower the town surveys,
O'er which our mounting sun his beam displays
The word, pronounced aloud by shrieval voice,
Leetamur, which, in Polish, is rejoice."

and

"Five days he sat for every cast and look,
Four more than God to finish Adam took."

In the six medals connected with the fate of the Duke of Monmouth we find some curious sidelights on the state of English politics in 1685. The tragedy of Sedgemoor began by the landing of Monmouth at Lyme-of-the-King in Dorset in June of that year. It was within the confines of the same county that his arrest was effected after his defeat in Somerset on July 6th. Out of these six medals (examples of the whole of which are in the collection of the writer) five ridicule somewhat timidly and obscurely his attempt to gain the crown. The first medal described by Hawkins is the work of Jan Smeltzing. In this we have a bust of the Duke, with long and abundant hair, wearing a breastplate decorated with the fulmen. On the

FIGURE 215. Portrait Medal of Cardinal Henry of York, the last of the Stuarts.

FIGURE 216. Portrait Medal of Princess Louise, the sister of the Old Pretender.

FIGURE 217. A Medal of 1746, issued by the Hanoverians.

reverse is a Roman soldier attempting to tear open a lion's jaw and a Latin inscription which may be translated "It has succeeded little, I have acted diligently." It looks as if the medallist was, up to the last moment, sitting on the political fence. The second medal (by Bowers) is more decisive in its tone. Monmouth in trying to seize the three crowns has fallen into the sea. On the reverse (in Latin) are the words "The Gods derided, July 6th, 1685." In the third medal, the work of an anonymous artist, Monmouth is portrayed as falling from a column surmounted by the three crowns, surrounded by military trophies. Above the pillar is the word "Providentia"; below, "Improvidentia." There is no date. Hawkins says that "when Monmouth landed in Dorsetshire he proclaimed himself King under the title of James II, and exercised the royal privilege of touching for the King's evil." It may be noted that the example of this medal in the Royal Collection at Stockholm is stamped with the date 1685, and the base of the column is inscribed M. JUL, the month in which Monmouth was defeated and executed. The fourth Monmouth medal in my collection is seen in Figure 211. The bust and hair are arranged very much as in the other specimens. The legend runs: "JACOBUS . DUX . MONVMETHENSIS." Below are the words, "G . BOWERS . F." On the reverse we see two infant genii amid clouds supporting a coronet over the cypher, J . E . D . M . (James Edward, Duke of Monmouth). There are cherubs above and below. The legend is CAPVT . INTER . NVBILA ("His head is amongst the clouds"). This is capable of various interpretations, but as Bowers worked for the Court, and has put his name to the production, it was probably in derision that he places the head of Monmouth in the clouds. There can be no mistake about the fifth medal, executed by Jan Smeltzing. In this the Duke's hair is short, and there is no drapery. The head is surrounded by the words JACOBUS INFELIX DUX MONUMETHENSIS. On the reverse is the decollated head on the ground spouting out blood and the words, HUNC SANGUINEM LIBO DEO LIBERATORI ("His blood I pour out to God, the Deliverer"). Also CÆSA CERVIX LON JULY $\frac{1}{2}\frac{3}{5}$ 1685 ("Neck cut, London, July $\frac{1}{2}\frac{3}{5}$, 1685"). This is the least rare of the six medals.

On the last of the series is a bust of James II resting on four sceptres, and so on. Neptune in his car, and ships in the distance. On the reverse is a pedestal inscribed, AMBITIO MALESUADA RUIT ("Ill-advised ambition fails"); on it Justice, trampling on a serpent, weighs three crowns against the sword, the torch and the serpent of Discord. At her feet lie the bodies of Monmouth and Argyle; their heads are on blocks inscribed, JACOBUS DE MONT MOUT & ARCHIBALD D' ARGYL. Above, the Sun; on one side, lightning darting against the forces discomfited at Sedgemoor; on the other are seen two heads fixed over the gate of the Tower. Monmouth was executed on July 30th, 1685. It is curious to note that the royal shield on the obverse has Scotland in the first and fourth quarters as on the Scottish coins. The anti-Jacobite medal, the medal of Princess Louise, daughter of the Old Pretender, the Jacobite medal of 1745, the Hanoverian medal of 1741 and the medal of Cardinal of York, Henry IX of England, according to his tomb at St. Peter's, bring the story of the Stuarts down to its close,* illustrating the strong interest inherent in the study of these striking and instructive memorials of an eventful past—Addison's "Critics in Rust."

*See Figures 212 and 214—217.

QUERIES.

Readers are invited to send in Questions and to answer the Queries which are printed here.

4. MENDELISM.—At a recent lecture I attended on "Mendel's Law of Heredity" the lecturer explained how from the union of dominant with recessive the result would be: one dominant, two unaffected transmitters (dominants apparently, but with the faculty of breeding hybrids and recessives) and one recessive. The lecturer illustrated this by the blending of a long pea with a dwarf pea. The offspring would be (in proportion) as follows: One pure long pea; two apparent long peas, but also possessing the germ of the dwarf pea; and one pure dwarf pea.

A gentleman who had not quite understood the lecturer on this point, questioned the latter afterwards, taking as example soft English grain and hard Manitoba grain. The lecturer explained the matter to him, showing how the result would be one dominant, two unaffected transmitters and one recessive, but stated that he could not say which kind of grain would be the dominant.

Now is there any means of telling beforehand in the case of a blend which is going to be the dominant?

Possibly I may make my point clearer if I give another example quoted by the lecturer—the case of a sweet seed and a bitter seed. The result, said the lecturer, would be —(1) one sweet; (2 and 3) two sweets with the power of propagating sweets and bitters and (4) one bitter.

Now in this case the sweet seed is the dominant. Why is this so? Why should not the result have been as follows:—(1) one bitter; (2 and 3) two bitters with the power of propagating bitters and sweets, and (4) one sweet.

To sum up, in the case of a blend, how can you tell (if you can tell), which is going to be the dominant and which the recessive? S. F. G.

5. ASTRONOMY.—In *The Nautical Almanac* under Moon culminating Stars in the sixth column is given the variation of the Moon's R. A. in one hour of longitude.

I have read what is said in the explanation, and I wish to know, especially by an example from the *N. A.* of 1911 or 1912, how similar figures could be obtained direct; (*i.e.*, without interpolation from those given) for a place, say five and a half hours, in east longitude, instead of at Greenwich.

BERARS, INDIA. A. G. W.

6. WIND PRESSURE.—May I ask if some reader of "KNOWLEDGE" would kindly explain why it is that wind records are almost invariably given in terms of velocity, viz., in miles per hour, and are but rarely expressed in terms of pressure, say, in pounds per square foot, which would seem to be more directly and easily ascertained and would certainly be of more practical use, at any rate for the purposes of the engineer. I should also be glad to know if there is any reliable instrument in use which records actual wind pressure exerted on a given flat surface at stated periods.

HYTHE. W. P.

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NOTES.

ASTRONOMY.

By A. C. D. CROMMELIN, B.A., D.Sc., F.R.A.S.

THE AQUARID METEORS AND HALLEY'S COMET.—In a recent number of "KNOWLEDGE" I referred to Mr. Olivier's observation of the Aquarids and his demonstration of their connection with Halley's Comet. The *Bulletin of the Astronomical Society of Mexico* for March, 1912, contains an article on the same subject by Señor M. M. Marron, from which I quote the following particulars. I have condensed his narrative:—

"At half-past three on the morning of May 5th, 1910, an immense ball of fire appeared to proceed from the tail of Halley's Comet. It moved swiftly, lighting up the sky and the landscape.

"According to a telegram from Heredia on the morning of May 10th, 1910, there was observed in the city of Costa Rica a shower of shooting stars, fifty-three being counted in half-an-hour."

Aërolites are also referred to on May 11th, 13th, 18th, but their connection with Halley's comet is doubtful. The one of May 5th appears to have been probably an Aquarid, the radiant being $338°-2°$ (Denning) near Eta Aquarii; the comet at this time was in $1° + 9°$, so that its tail would have passed slightly north of Eta.

THE NEW STAR IN GEMINI.—This object was discovered by M. Enebo at Dombaas, Norway, on the evening of March 12th, when it was of the fourth magnitude. The survey plates taken nightly at Harvard Observatory have enabled us to trace its past history, and to say that on the evening of March 10th it was fainter than the eleventh magnitude, while on the following day it had reached the fifth. It took a few days reaching its maximum, when it was distinctly brighter than θ Geminorum, and little inferior to the third magnitude; then a pretty rapid decline set in, and it fell two magnitudes in two days. Like Nova Persei of 1901, the fall was oscillatory; thus, at Cambridge the magnitude was deduced as 5·5 on March 20th, 4·7 on March 25th, 5·5 on March 26th; by the end of the month it was down to the sixth. Its position for 1912·0 is $6^h\ 49^m\ 11^s{\cdot}75$, N. $32°\ 15'\ 6''$; that of Turner's Nova of 1903 for 1900·0 was $6^h\ 37^m\ 48^s{\cdot}86$, N. $30°\ 2'\ 39''$. The two Novae are only some 3° apart; it is rather remarkable to have two outbreaks so closely adjacent within nine years.

Herr Kaiser, of Heidelberg, has found a fifteenth-magnitude star on a Wolf-Palisa plate, taken in 1909, which agrees with the place of the new star within at most 2″. The identity of the two is highly probable but not quite certain. It will be remembered that Nova Lacertae of last year was identified with a fourteenth-magnitude star which had been photographed some years before. The spectrum of the new star seems to have been of the F5G, or Procyon, type on March 14th. On the next night the usual bright and dark bands of novae had appeared: these indicated velocities of some six hundred kilometres per second, but the narrow absorption lines gave velocities of recession of twenty kilometres per second. Apropos of the variations in light of the Nova, it is appropriate to refer to the new catalogue of nine thousand eight hundred stars by Mr. T. W. Backhouse. It includes the whole sky from pole to pole, and shows all stars visible to an ordinary eye, including some of the seventh magnitude where there are two stars of that magnitude within a few minutes of arc of each other so that they might be seen as one sixth-magnitude star. The magnitudes have been discussed and reduced to a common system. A map showing magnitudes can be made of any region in a few minutes and the variations in brightness of novae traced from night to night.

BOTANY.

By PROFESSOR F. CAVERS, D.Sc., F.L.S.

NEW ZEALAND SAND-DUNES.—In continuation of his previous work on the dune areas of New Zealand, Cockayne (*Report, Dept. of Lands, N.Z.*, 1911) has published a detailed and fully illustrated account of his studies on the sand dunes of the colony. For the botanist interested in Ecology in general, this report, consisting of seventy-six quarto pages, with seventy-two plates, and published at the low price of 1s. 9d., is of importance as being the best all-round account of dune vegetation that has yet been published.

After dealing with the geology, topography, and general environmental factors, the author gives lists of the various plants of the dunes, numbering in all nearly one hundred and fifty species, and proceeds to deal with practical methods for the reclamation and preservation of dune areas as farmlands or grazing grounds. The marram-grass (*Ammophila arenaria*) is recommended as the best of the sand-binding plants. Lupins are suitable after the moving sands have been fixed and protected from moving dunes, and for use at a later stage various grasses, and so on, are described. The numerous photographic illustrations show the various dune plants in their habitats, as well as phases in the formation and reclamation of dunes, and so on.

Since the sand dune area of New Zealand extends over about three hundred thousand acres, the question of reclamation is one of national importance, and some action by the Government of the colony is likely to result from Cockayne's investigations and recommendations.

MARSH PLANTS.—The third part of Glück's *Biologische und morphologische Untersuchungen über Wasser und Sumpfgewächse* (G. Fischer, Jena) forms an important contribution to the growing literature of detailed biological Ecology, as distinguished from that of botanical survey work. This third part ("Die Uferflora") deals with over one hundred European species of marsh plants, and extends to over six hundred pages, with eight fine double plates and over one hundred text-figures.

The author describes in detail the various forms of marsh plants, according to whether they develop under their optimum conditions of growth (with the roots in water or saturated soil and the shoots in the air) or under less favourable conditions (submerged in deep water, or on the other hand stranded on a dry substratum). The fresh-water flora is divided into three zones:—(1) submerged flora, (2) floating-leaf flora, (3) marsh flora. The last named is again divided into two classes—one including plants which are adapted rather for life in air, *e.g.*, *Typha*, *Acorus*, *Iris*, *Caltha*, *Menyanthes*; and the other including plants adapted more for aquatic life, under which heading come the great majority of marsh plants. In the first class, the plants when growing in water suffer reduction of all the vegetative parts; while the plants of the second class (*e.g.*, *Peplis*, *Scirpus*, *Littorella*, *Ranunculus lingua*, *Oenanthe fistulosa*, and many others), on the contrary, show increase in their vegetative parts when growing in water.

Glück pays special attention to the various forms of the leaves of marsh plants. He adopts Goebel's distinction between "homoblastic" types with only one form of leaf, and "heteroblastic" types, in which the primary and the later leaves differ in form. In cases where submerged leaves are formed, differing from the aërial leaves, the former are of a primary type. It seems a pity that the author has not dealt with the minute structure of the various leaf-forms which he describes, but apart from this he brings together an enormous amount of information concerning the morphology of both

vegetative organs and flowers, periodic phenomena, vegetative reproduction, germination, and other aspects of marsh vegetation, including much that is new. One of the most remarkable plants which he describes is an aquatic dodder, *Cuscuta alba*, which grows as a submerged parasite on various water-plants in Sardinia and Algeria.

VEGETATION OF CAITHNESS.—In *The Vegetation of Caithness considered in relation to the Geology*, C. B. Crampton has published, under the auspices of the Committee for British Vegetation, a most important and interesting study of vegetation as developed under the influence of geological and physiographical factors. In the Preface, Dr. W. G. Smith, who has done so much pioneer work in botanical survey—along with his brother, the late Robert Smith, he laid the foundations of systematic field-work and mapping of vegetation in Britain—points out that this memoir on Caithness proceeds beyond a mere description of the vegetation. While this descriptive work has been the main theme in the successive memoirs published by R. and W. G. Smith, Smith and Rankin, Moss, Lewis, and others, "there has been an increasing tendency to consider other aspects of the ecological grouping of plants. In each area dealt with, new plant-communities have been discovered and compared with other known types, both as regards floristic composition and ecological characters. It has been more and more realised that some ecological groups are of a higher order than others, and so have arisen the concepts of a greater unit, the plant formation, and lesser units—subformations, associations, societies, and so on. The relation existing between plants associated together in plant-communities, and the habitats occupied by each vegetation unit, has received greater consideration in each successive memoir."

As Dr. Smith points out, this Caithness memoir is the first attempt by a member of the Geological Survey to deal with the vegetation of an area on which he has worked, and this is especially welcome since in former botanical surveys sufficient attention has not been paid to the geological considerations bearing on the topography or physiography of the district dealt with. The chief theme underlying this memoir is the distinction of stable from unstable formations, and such topics as the influence of physiographic factors on the historical development of the vegetation, and the effect of glaciation on plant distribution, are discussed in a way not hitherto attempted.

The author discusses in detail the conditions determining the formation of peat since early post-glacial times, and the changes in the vegetation of the peat leading on to the present period of retrogression—about two-thirds of Caithness are now covered by peat, which was formerly much more extensive. The accumulation of peat has been favoured by (1) the plateau-like topography and its influence on the prevalent winds, rainfall, and drainage; (2) the condition of the surface of the land at the retreat of the ice-sheet, when the surface was either bare rock or drift, the soil-bacteria that promote nitrification were banished and returned slowly owing to the cold and the accumulation of acid humus, and stagnant conditions alternated with hard unweathered surfaces of rock or boulder-clay; (3) the latitude of Caithness and its geographical position relative to the edge of the continental shelf.

The subsequent history of the vegetation is indicated by plant-remains in the peat. "At first the plant associations were probably of a tundra-like nature, shallow-rooted, creeping, or cushion-like, and periodically frozen or soaked in ice-cold water. As the cold grew less, and more humus accumulated, a bog flora established itself in the hollows, but over wide areas a dwarf scrub of birch seems to have obtained a footing." Later came a forest period with pines, which subsequently disappeared, their advent and decline being attributable probably to climatic changes. In recent times the occurrence of extensive areas of peaty moorland has acted as a barrier on the landward side to all plants incapable of competing with moorland associations, hence plant-migration has taken place mainly along the coast and river systems, and by the aid of man.

The author proposes that dominant plant formations which occupy ground comparatively stable from the geological standpoint should be termed stable or ***palaeogeic*** formations, since the ground they cover mainly owes its features to past geological processes; while for the limiting and dissecting formations, often found in all stages of progressive association and succession, from the migratory nature of the geological agents of erosion and deposition, he suggests the terms migratory or ***neogeic*** formations, since the ground they occupy owes its features to recent geological processes. In the case of Caithness, this method resolves the vegetation into one dominant stable formation, the moorland, and several migratory formations in the belts along the coast, the ramifications of the drainage system, and the alpine centres. These various formations are then dealt with in detail, with numerous examples of associations in representative localities.

The author links up his classification with that of Cowles, who has defined three types of cycles of vegetative succession—(1) regional successions, due to secular change, the most important in Britain being the post-glacial invasion of southern forms into northern regions, accompanying and following the retreat of the ice; (2) topographic successions, of much greater rapidity and associated with topographical changes resulting from the activities of such agents as running water, wind, ice, gravity, and leading in general to erosion and deposition, the influence of erosion being generally destructive to vegetation or at any rate retrogressive (tending to cause departure from the mesophytic type) while that of deposition is constructive or progressive (tending to cause an approach towards the mesophytic type); and (3) biotic successions, due to plant and animal agencies. The regional successions are exemplified in Caithness in successions of plant remains, tundra, forest, and moorland, in the peat-mosses, such as were first demonstrated in Denmark by Steenstrup and recently in Britain by Lewis; the plant formations effecting these regional successions correspond to Crampton's stable or neogeic formations. The topographical successions (normally limited to the coastal belt, river systems, and alpine centres) and the biotic successions are included in Crampton's migratory or neogeic formations.

Altogether, this memoir may be said to break a good deal of entirely new ground as regards descriptive ecology in Britain. A notable feature in the author's thorough and instructive treatment of the vegetation of his area is the inclusion of the more abundant and characteristic mosses, liverworts, and lichens in his floristic lists, and his demonstration of the important part played by these plants in the various associations. The importance of the peat-mosses (Sphagnaceae) has, of course, long been realised, but comparatively little attention has been paid by previous writers on descriptive ecology to other mosses which, along with lichens and hepatics, enter largely into the composition of various plant-societies and in places form a striking and conspicuous element in the vegetation. For instance, Crampton distinguishes a Rhacomitrium bog association, in which the woolly fringe-moss (*R. lanuginosum*) is dominant over considerable areas. It is characteristic of the author's thoroughness that he has not been content with "*Sphagnum* spp.," but has had his sphagnums named, as well as the lichens and liverworts. In connexion with the latter group, mention may be made of Macvicar's recent work on the distribution of the liverworts of Scotland.

IRON BACTERIA.—Our knowledge of these remarkable organisms, largely due to the work of Winogradsky and of Molisch (see "KNOWLEDGE," March, 1911, page 105), has recently been supplemented by Lieske (*Jahrb. für wiss. Bot.*, 1911). This writer has studied *Spirophyllum ferrugineum*, which, unlike *Leptothrix* studied by Molisch, does not grow in a medium containing organic matter, nor in an iron-free medium, nor in a medium containing iron salts other than ferrous carbonate or bicarbonate, nor salts of any of the other metals. Lieske's most important result, however, is his experimental proof that this bacterium can utilise the carbon of carbon dioxide in the total absence of any other source of carbon. The nutrient medium contained inorganic salts in solution,

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iron filings were added, and carbon dioxide supplied to the extent of one per cent. of the air in the flask. With inorganic salts, metallic iron, and no other source of carbon than that supplied indirectly by the action of carbon dioxide on the iron (forming ferrous carbonate), there was a marked increase in the carbon content of the culture, masses of the bacterial filaments being formed by growth. The bacterium must, in order to gain one part of carbon, produce from the ferrous carbonate no less than seven hundred parts of ferric oxide.

Carbon dioxide is utilised in a similar manner by various other oxidising bacteria, such as the nitrate and nitrite bacteria, those which convert thiosulphates into tetrathionic and sulphuric acids, those which split up hydrogen peroxide, and those capable of oxidising methane and carbon monoxide and utilising the carbon these substances contain.

CHEMISTRY.

By C. AINSWORTH MITCHELL, B.A. (OXON.), F.I.C.

RADIUM IN THE WATERS OF BATH.—It has long been known that artificial preparations of mineral waters do not always produce the same effects as the natural waters, however closely they are made to correspond in their chemical composition. The chemists of the eighteenth century accounted for this by the theory that natural mineral waters contained a certain vital principal, "the soul of the waters," to which they owed their specific activity, and later this volatile principle was identified with carbon dioxide, or "fixed air," as it was then termed. During the last century there was a tendency to attribute the cures apparently effected by certain classes of mineral waters, in which nothing remarkable could be discovered, to the simultaneous effects produced by good air and regular diet which accompanied the "taking of the waters."

In 1895 the element helium was discovered, and a few years later the gas was found to be a constituent of many natural mineral waters. It was, for instance, shown to be present in the gases escaping from the King's Well at Bath, in the proportion of 1·2 parts per thousand, but the significance of this fact was not made clear until in 1903 there came the discovery by Sir William Ramsay and Mr. Soddy that helium was a product of the disintegration of radium, and that its presence in the water was thus an indication of radioactivity.

The presence of radium itself was detected by the Hon. R. J. Strutt both in the waters of Bath and in the deposits from the hot springs, and this has been followed by the recent estimation by Sir William Ramsay of the amounts of niton (radium emanation) in the different waters of Bath and the gas emitted by them.

The report of this investigation is published in a recent issue of *The Chemical News* (1912, CV., 134), and the interesting results there given have an important bearing upon this question of the therapeutic action of waters like those of Bath.

The gas emitted from the King's Well was estimated to amount to four thousand nine hundred and twenty-seven litres in twenty-four hours, and consisted of three hundred and sixty parts of carbon dioxide and nine thousand six hundred and forty of nitrogen, and so on, per ten thousand. The nitrogen contained 73·63 per cent. of argon, 23·34 per cent. of neon and 2·97 per cent. of helium.

The Pump Room water contained in solution 18·5 parts of gas per thousand, consisting of 6·9 parts of carbon dioxide and 11·6 parts of nitrogen and its companions.

In measuring the amounts of radium and its emanation (niton), the latter was calculated into the corresponding quantity of its parent, radium, that would have produced it. The method may best be made clear by quoting Sir William Ramsay's words: "Suppose one gramme of radium to be dissolved in water, say as chloride or bromide. It is continually giving off niton, but at the same time the niton is as continuously disappearing with the formation of radium, A, B, C and D. There will arrive a time when the production of niton from the radium will have ceased to increase, because as it is produced it decays, and the rate of production is then equal to the rate of decay. The amount of niton will therefore increase up to a certain point; that point is when 0·6 of a cubic millimetre of niton has been produced. The weight of one cubic millimetre of niton is almost exactly one hundredth of a milligramme; hence 0·6 cubic millimetre weighs six thousandths of a milligramme. This is the weight of niton which is equilibrium with one gramme of metallic radium."

Estimated by this method the following results were obtained in the examination of the waters of Bath:—

	Milligrammes per million litres.
Radium in the water of the King's Well ...	0·1387
Niton (radium emanation) „ „ „ ...	1·73*
Niton „ „ „ Cross Bath ...	1·19*
Niton „ „ „ Hetley Bath...	1·70*
Niton „ in gases from King's Well ...	33·65*

* These figures are the weights of radium capable of forming the amounts of niton found.

EFFECTS OF ROAD-SURFACINGS ON FISH LIFE.—The modern method of tarring roads to prevent dust has led to numerous complaints that fish in streams near the road have been destroyed by the poisonous dust. An investigation to ascertain the effects upon fish of various compounds present in substances used for treating roads has, therefore, been made by Mr. W. A. Butterfield (*Surveyor*, 1912, XLI, 277). From the results of the experiments it appears that ammonia and many of its salts, gas liquor solutions, phenols and tars containing much phenol, and light tar oils capable of forming films on the surface of the water, are all more or less toxic to fish. On the other hand, napthalene, coal-tar, pitch, and certain kinds of asphaltum are not distinctly injurious to fish, while there is no objection to the use of calcium chloride solutions. Films of heavy automobile oil on the surface of the water have also no injurious action upon the fish.

The general conclusions based upon these experiments is that the tar for allaying the dust in roads should consist of coal tar or a mixture thereof with carburetted water-gas tar, with a specific gravity of not less than 1·18 at 15° C., and that it should contain not more than one per cent. of gas liquor (the ammonia in which must not exceed five grains per gallon of tar), one per cent. of light oils, and three per cent. of crude tar acids. This will ensure safety to fish life, provided that not more than a twentieth part of the area draining into the water has been tarred.

Incidentally it is pointed out that there is some risk of injury to fish from the washings from stable manure finding their way into the water, and that for the same reason the use of sodium nitrate as a fertilizer is attended with less chance of injury to fish than the use of ammonium sulphate.

GEOLOGY.

By G. W. TYRRELL, A.R.C.Sc., F.G.S.

THE GEOLOGY OF THE COUNTRY AROUND OLLERTON.—A Survey Memoir just issued with this title describes the country between Newark and Mansfield, Nottinghamshire. The ground is mostly occupied by Triassic rocks, with small tracts of Permian and Lias, all being underlain by Coal Measures which, although not exposed in the Ollerton district, are continuous with the visible Coal Measures in the adjoining area to the west. The extent and availability of the concealed coalfield is, of course, the chief economic interest of the area.

The Permian rocks were deposited on an evenly denuded slope of Coal Measures, directed nearly due east and falling at the rate of one hundred and ten to one hundred and twenty feet per mile. A considerable thickness of Coal Measures was lost by denudation before the deposition of the Permian rocks. The coal seam usually sought for in borings is the Top Hard. In the Mansfield Colliery workings, this seam dips three degrees (276·7 feet per mile) to the north-east. If this dip continues within the Ollerton district, the Top Hard Coal would plunge below the limiting depth of profitable working (4,000 feet) in the area bordering on the Trent. To the south and west of the Ollerton district, however, the dip is known to decrease north-eastward until it is a little over a degree (92·16 feet per mile). If this lowering of dip continues to the

east and north-east of Mansfield, the Top Hard Coal may be found at workable depths throughout most of the area described in the memoir.

COPPER NICKEL ORES IN EAST GRIQUALAND.—A great nickel-bearing intrusion, very similar to that of the famous Sudbury district of Canada, has been found at Insizwa, East Griqualand, and has been described by A. L. Du Toit in *The Fifteenth Annual Report of the Geological Commission of Cape Colony* (1910). The intrusion consists mainly of gabbro, with olivine- and hypersthene-bearing varieties, intruded into the shales and sandstones of the Beaufort Series, which it has intensely metamorphosed. The chief ore minerals are pyrrhotite, chalcopyrite, and pentlandite. The latter, of course, is the chief nickel-bearing mineral, but the other two are also slightly nickeliferous. These ores are confined more or less to the contact of the gabbro with the hornfelsed sediments, impregnating the latter to a small extent, but becoming more abundant in, and sometimes restricted to, the igneous rock, of which the sulphide ores appear to be primary constituents.

As in the Sudbury district, the Insizwa intrusion forms a huge basin-shaped mass; but the shape is original, and is not due, as at Sudbury, to the sinking of the sediments in the basin. The strata have been intensely altered, in some places to a depth of two hundred feet below the intrusion. The resulting hornfels is much mixed up with the gabbro near the contact, and is also penetrated by strings and patches of granitic rock. The copper-nickel ores occur along the lower contact of the gabbro, and never more than a few feet away from the igneous rock.

The gabbro must be regarded as the source of the ore, for a petrological examination of the ore-bodies shews that the ores formed a portion of the once molten magma, and that during the cooling they segregated towards the lower margin of the mass, impregnating the adjacent strata to a small extent. The order of crystallization of the chief ore minerals is (1) Chalcopyrite, (2) Pentlandite, (3) Pyrrhotite. The olivine and pyroxenes in the igneous rock are beautifully fresh, and are idiomorphic to the ores; but the latter appear to have crystallized along with the biotite. In places the ore is moulded on the biotite, in others it is intergrown to a small degree, but commonly the biotite forms a fringe around the ores. No veins of sulphide ore are to be found penetrating the gabbro minerals as one would expect had water deposition been the agent of their formation.

There is every stage from a gabbro or norite with minute scattered particles of ore to a rock in which ore and silicates are in equal proportions, and finally to an almost pure ore with a few patches of silicates scattered through it. The pure ore-bodies are usually sheet-like in form, and are roughly parallel to the adjacent contact, grading into normal gabbro. There is a gradual decrease of basicity in the mass from the bottom to the top. Towards the top the rock becomes olivine-free, and a quartz-felspar micropegmatite is developed.

It is to be hoped that future mining developments will show that the Insizwa Range is similar to the Sudbury district in the richness of its ore-deposits, as well as in their form and genesis.

THE DATA OF GEOCHEMISTRY.—Dr. F. W. Clarke and the United States Geological Survey deserve the thanks of all geologists for the second edition of "The Data of Geochemistry," issued recently as Bulletin 491. All that relates to the chemistry of geology is here dealt with in detail, and the geologist will be no less thankful for the scope of the work than for the extremely full references to the vast and widely-scattered literature of the subject. Originally issued in 1908 as Bulletin 330, the book is now revised, enlarged and brought thoroughly up-to-date. The petrologist and mineralogist, as well as workers in other branches of the science, will find in this book a perfect mine of facts relating to the chemical side of their study.

THE MESOZOIC ROCKS OF KENT.—The mesozoic rocks obtained in four of the principal borings for coal in Kent have been examined in great detail by Messrs. G. W. Lamplugh and F. L. Kitchin, of the Geological Survey, and the results published in a recent Survey Memoir. A knowledge of the range and character of the Mesozoic rocks in the south-east of England is of much importance as bearing on the prospects of finding coal at a workable depth in the Palaeozoic floor which underlies the area. Such investigations lead to conclusions as to the thickness of rock to be penetrated before the coal-bearing strata are reached, and may afford indications as to the localities where borings may be undertaken with the most profitable results. Four borings, at Dover, Brabourne, Pluckley, and Penshurst, ranging on an east-west line of forty-five miles, are described.

Some very important results have been obtained, which have no little bearing upon the economic problem. The Lower Cretaceous rocks underground vary considerably from their outcrop characters. At Dover the palaeontological evidence establishes an unconformity between the Hastings Beds and the Kimmeridge Clay, only the lower part of the clay being represented. To the west, however, the upper part of the Kimmeridge Clay is so greatly developed that the Penshurst boring failed to penetrate to its base. This thickening is shared by all the Jurassic and Lower Cretaceous strata, and indicates a long-continued depression in this region. The downward movement ceased before the deposition of the Upper Cretaceous, and the Wealden anticline has since been superimposed upon the whole area. Characters indicative of a shore-line to the north-east have been observed in several of the Jurassic rocks.

METEOROLOGY.

By JOHN A. CURTIS, F.R.MET.SOC.

THE weather of the week ended March 16th, as set out in the Weekly Weather Report of the Meteorological Office, was generally unsettled, although in some places no rain was recorded. Thunder was heard in Hampshire on the 15th, and sleet or snow was experienced in Ireland towards the end of the week.

Temperature was considerably above the average in all districts, but only in Ireland, S. did the maximum reach 60°. The highest readings were 63° at Foynes and Killarney on the 13th, with 62° at Kilkenny, and 61° at Cahir. In Jersey the maximum was only 57°. The lowest readings were below freezing-point in all districts except Ireland, N. and the English Channel. The lowest of the minima were 21° at Balmoral and 25° at West Linton. On the grass the temperature fell to 18° at Balmoral and to 19° at Newton Rigg, but at depths of one foot and four feet the earth temperature was higher than usual in all parts.

Rainfall was below the average in Scotland, N. and E., and just equal to it in England, E. and S.E. In all other districts it was in excess, though not as a rule to any great extent. Sunshine was slightly above the average in Scotland, N., and Ireland, S., but below it elsewhere. The district values varied from 1·6 hours per day (13%) in England, E., to 3·8 hours per day (33%) in Ireland, S. At Westminster the average duration was 1·2 hours per day, or 10 per cent. of its possible duration.

The temperature of the sea water round the coasts varied from 40° at Berwick and Scarborough to 51° at Scilly.

The weather of the week ended March 23rd was very unsettled. Over a large part of the Kingdom precipitation occurred every day, generally in the form of rain but sometimes in that of sleet, snow or hail.

Temperature was not far from the mean but was below the average in most districts. Frost was experienced in all districts except the English Channel. The lowest readings reported were 23° at West Linton, and 26° at Fort Augustus. In Jersey the minimum was 35°. The highest maximum was 60° at Killarney, the next highest being 55° at Cambridge and Cirencester. On the grass, readings down to 19° at Ranceby and Newton Rigg and 20° at Worksop were reported, while the temperature of the earth, both at one foot and at four feet depths was from 2° to 3° higher than usual.

Rainfall was above the average in all districts except Scot-

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land, N. and W. In England, S.E., it was more than four times as much as usual. On the 19th 1·06 inches (mostly sleet) fell at Markree Castle, and 1·02 inches at Stonyhurst.

Sunshine was in defect in most parts, but in Ireland, S. it was a little in excess. The district values ranged from an average of 2·2 hours per day in the Midlands to 4·5 hours per day in Ireland, S. At Westminster the average was 1·5 hours per day or 13 per cent., while at Portsmouth it was 4·1 hours per day, or 34 per cent.

The mean temperature of the sea water was higher than usual and ranged from 41°·0 at Berwick to 49°·0 at Newquay. The week ended March 30th was generally fair and dry over the southern half of the Kingdom, but elsewhere rain was frequently experienced. Thunderstorms occurred on the 26th, 29th and 30th, and showers of hail, sleet, or snow were reported at many northern stations late in the week.

Temperature was above the average in all parts, by as much as 7°·1 in England, E., and maxima of 60° and above were common. The highest readings were 63° at Norwich, Geldeston, Raunds and Margate on the 25th. The minima were as a rule much higher than in the preceding week, and readings below freezing were reported only in Scotland, E., where minima of 28° were observed at Nairn and Balmoral. In Guernsey the lowest reading was 43°. On the grass the lowest reading recorded was 22° at Buxton. The earth temperature was again higher than usual. Rainfall was in excess in Scotland, England, N.W., and Ireland, N., but in defect elsewhere. In Scotland the amounts collected were in many instances more than twice as much as usual. At Glencarron and at Fort William the total for the week exceeded three inches. Sunshine was in excess in Scotland, N. and the Eastern districts, and in defect elsewhere. In Scotland, E. the average was 5·7 hours per day, or 45 per cent., while in Ireland, N. it was only 2·5 hours or 20 per cent. At individual stations the contrast was still more marked, Aberdeen having 6·4 hours per day (51 per cent.), while Valencia had only 1·8 hours per day or 15 per cent.

The temperature of the sea water ranged from 41° at Berwick and Scarborough to 52° at Scilly.

The week ended April 6th, was generally fair except in the N. and N.W. Early in the week sleet and snow showers were experienced over a considerable area. Temperature was again above the average in all districts, the greatest excess being 3°·8 in England, E. The highest individual readings were also in England, E., being 69° at Clacton and Geldeston on the 6th, and 68° at Cambridge, Felixstowe and Raunds on the same day. In Jersey the highest reading was only 57°. In spite of the high maxima frost was reported in all districts except the English Channel. The lowest readings were 27° on the 2nd at West Linton and Llangammarch Wells. On the grass the lowest reading was 19° at Worksop; 20° was reported at a number of stations. At one foot and at four feet below the surface the ground was still warmer than usual, but the excess was less marked than in previous weeks.

Rainfall was more than three times the average in Scotland, N. In Scotland, W. it was also in excess, but in Scotland, E. it was normal, and in all other districts it was in defect. In the Midland Counties and in Ireland N. the total fall was less than one-third the usual amount. Sunshine was above the average in England, E., S.E., and N.W., and in the Midlands, while in Scotland, W. it was normal, and in the other districts it was in defect. The sunniest district was England, S.E. with an average of 5·9 hours per day (46%); the sunniest station was Margate with 7·1 hours per day (55%). At Westminster the average was 5·0 hours per day (39%). The mean temperature of the sea water varied from 41°·4 at Berwick to 51°·8 at Scilly.

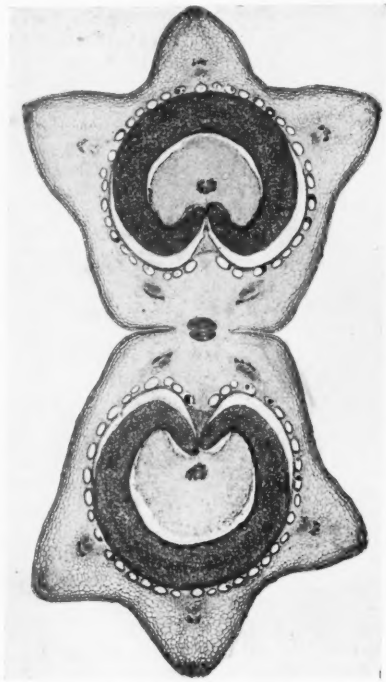

FIGURE 218. Transverse section of the double fruit of *Smyrnium*.

For description see Figure 219.

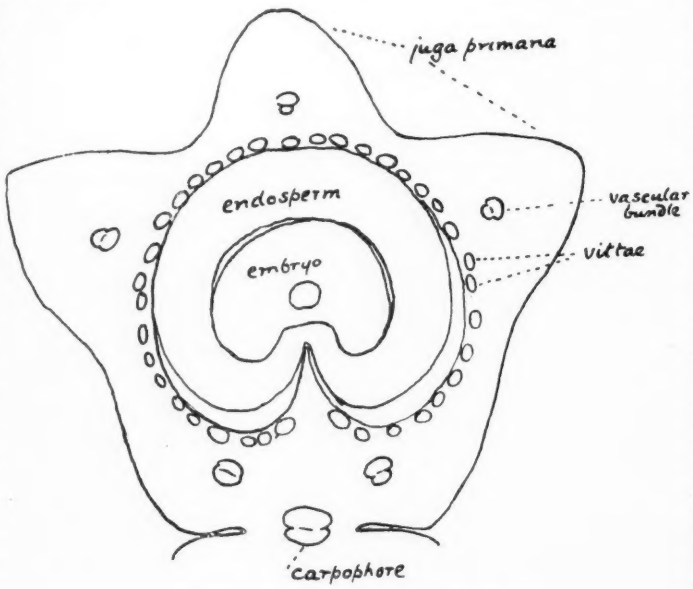

FIGURE 219. Key to Figure 218.

MICROSCOPY.

By F.R.M.S.

FRUIT OF SMYRNIUM. — The structure of the fruits of Umbellifers (parsleys, carrots, hemlocks, and so on), is particularly well seen in microscopical sections, and it would be interesting to form a collection of such preparations illustrating our native species. Some of the leading characters may be seen in Figure 218, taken from a photomicrograph of a transverse section of the double fruit of *Smyrnium*. Externally there are in this form three prominent ridges on each half of the fruit, the two internal ones blending with the corresponding ridges of the opposite side. Inside these we find the five vascular bundles; these ridges are therefore *juga primaria*, *juga secondaria* being ridges not corresponding in position to vascular bundles. (Figure 220 shows the relation of bundles to ridges in the stem of the sunflower.) We note also the centrally-placed *carpophore*; the *vittae*, or oil canals, in this instance closely surrounding the endosperm, which encloses the *embryo* (see also Figure 219). By some authors the order is classified according to the form assumed by the

endosperm; in this case it appears in section twisted round, like a coiled-up caterpillar, and we refer our specimen to the group Campylospermeae. The most familiar

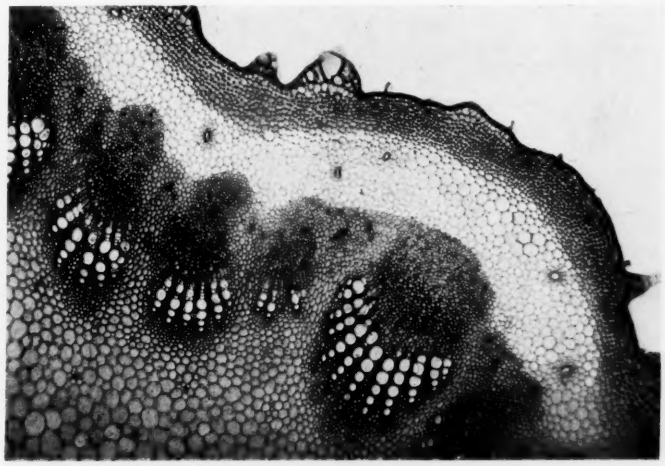

FIGURE 220. Cross Section of the Stem of Sunflower.

character of these "seeds" is their strong smell, due to the oil contained in the vittae, in most species. The well-known cymene phenol carvacrol, which can be made by boiling camphor with iodine, owes its name to *Carum Carui*, carvol (caruol) having been the term applied to the oxidised constituent of carraway oil, carvene (caruene) being the hydrocarbon. Pliny (N.H. 23 : 88) says that *oleum caryinum* is good for headache, so that it is possible that a substance allied to thymol was used for similar purposes in classical times; marjoram is used to anaesthetise Iulus in Aen. I, 692. Pliny indeed connects his *oleum caryinum* with *nux juglans*, but this is probably because he connects it wrongly with caryon, "a nut," the real word being caron and its adjective caroinon, whence wine and nuts have wrongfully attached themselves to the carraway throughout its literary history. Many of the terpenes seem to have been known to the ancients, and if we could get them correctly identified we might think better of the empiric medications of those distant days. The specific name *Carui*, given by Linnaeus, seems to be a latinisation of the vernacular name as still used in several European countries; and this itself is derived from Pliny's term, the mistaken orthography being shared by no less a person than Galen. To return to the twentieth century: these fruits, when duly fixed, are not difficult to sectionise, if care be taken to bring them to the right consistency; perhaps the best way is to embed them in paraffin, and cut them like ordinary histological sections, since in this case the block remains as a source of further specimens if such should be desired. The photographs were taken with the Zeiss thirty-five millimetres projection lens, illuminated with the Kohler system and the back of the aplanatic condenser.

E. W. BOWELL.

QUEKETT MICROSCOPICAL CLUB. — March 26th, Professor A. Dendy, D.Sc., F.R.S., President, in the chair. Mr. E. M. Nelson, F.R.M.S., exhibited "An Aplanatic Spot Lens." This, recently made by Messrs. Baker from his calculations, focusses parallel rays directly upon the object. Its N.A. is 1·3 and its focus eight millimetres. It is a single lens with a convex reflecting surface, which is also a concave refracting surface, the latter introduced to neutralise the aberration of the concave mirror.

Mr. Nelson also described "An Improved Chromatic Condenser." Owing to the many faults of the ordinary Abbe condenser it was suggested that it would be well to have a simple form of non-achromatic dark-ground illuminator that would be capable of doing real serviceable work, and also for ordinary work a cheap narrow-angled chromatic condenser with spherical aberration at a minimum. The first had already been done and was exhibited and described at the meeting of the Club in March, 1911. The new condenser now exhibited is a non-achromatic triple of 0·65 N.A. and of minimum aberration. It is composed of two menisci and one bi-convex.

A third paper by Mr. Nelson on "The Rousselet Compressor" was also read.

Mr. Earland brought before the Club's notice a very important paper on "The *Lagenae* of the South-West Pacific," contributed to the Club's *Journal* by Mr. Henry Sidebottom.

Mr. C. F. Rousselet, F.R.M.S., made a communication on *Notholca triarthroides* Skorikow, *Cathypna brachydactyla* Stenroos, and a new *Brachionus* from Devil's Lake, North Dakota, U.S.A. The new species was *B. spatiosus*, found in plankton material collected by Professor R. T. Young, in July, 1910. In shape and appearance the nearest forms are *B. latissimus* and *B. longipes* of Schmarda.

Mr. D. Bryce read a paper on three new species of *Callidina*. These were *C. nana*, *C. concinna*, and *C. decora*.

Mr. A. E. Conrady, F.R.M.S., read a paper on the resolving power obtainable with dark-ground illuminators. The *full* resolving power of an objective was only obtained when the dark-ground illuminator had three times the numerical aperture of the objective obtainable, or, stated in another way, the resolving power was equal to one-fourth that of the objective plus one-fourth that of the condenser. No higher resolving power can be obtained with dark-ground than will be given with an objective having a N.A. of 0·47.

Mr. A. A. C. Eliot Merlin, F.R.M.S., sent a note on a photograph of the secondary structure of *Navicula Smithii*. The photograph showed the structure described at the meeting of the Club, October 18th, 1907, and, the writer thought, left no reasonable doubt as to the objective reality of the markings observed. The photograph was taken at a direct magnification of ×2,900 with an apo. $\frac{1}{8}$th inch of 1·42 N.A. and an axial cone of 0·5 N.A.

Dr. T. W. Butcher sent a series of ten photomicrographs of

FIGURE 221. Section of the Thorax of a young Rat.

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the same diatom taken at consecutive foci from the white dot down to the black dot image.

KERNSCHWARZ.—In photographing sections, due contrast may be obtained by the screen and bathed plate method. But, where it is possible, I prefer to stain the specimen for this particular purpose, and use ordinary process plates with the Bolt Court developer. Kernschwarz, recommended long ago for this purpose by Bolles Lee, is an excellent stain for such specimens. It is especially good when one desires to show sharply and distinctly the general appearance of a section. Figure 221 is a section through the thorax of a young rat done by this method; lungs, oesophagus and vagi, aorta, thoracic duct and pleurae will be readily recognised. Carmine preparations are much less satisfactory; one is shown in Figure 222(vermiform appendix, injected).

E. W. B.

ARRHENURUS INSULANUS KOEN.—In August, 1894, I found in a small pond in the Warren, Folkestone, a beautiful dark red female Arrhenurus, which I could not identify. It is always very difficult to identify a species of Arrhenurus from the female as the females are so much alike. With the males it is comparatively easy because they all exhibit a distinct structure from one another. In 1896, I again visited the same pond and did all I could to find a male or at least more females, but I had no luck. I can only conclude that during the two years the pond had been dried up, and in that case all the Hydrachnids that were there in 1894 had died out, so when I published my list of Water Mites found in the Warren in 1894 and 1896 I mentioned that I had found one particular female Arrhenurus I could not name for want of the male. (See Figure 223.)

FIGURE 222. Vermiform appendix, injected.

In October, 1899, Mr. Halbert, of Dublin, sent me a female he had found in Ireland, which on examination turned out to be the same species, only this specimen was not quite fully developed. Here again the male was not taken, so it still went unrecorded and unnamed.

In 1911, Dr. F. Koenike, of Bremen, found the same species in North Germany, but curiously enough the male was still wanting. Dr. Koenike is one of the greatest authorities we have on the Hydrachnidae, and was sure it had never been named, so named it at once as *Arrhenurus insulanus*. There is always a certain amount of risk in this because we have several male Arrhenurus which have been named, but at present do not know the proper females to place with them. This particular female, however, although of the usual shape, has very unusual genital plates, as can be seen in Figure 224.

I take this opportunity to place the name *Arrhenurus insulanus* Koen, on the British list. But the object of this note is more with the idea of inducing some of our pond hunters during the coming season to find the male, which, to judge by the size of the female and its beautiful colouring, must be a very handsome creature.

CHAS. D. SOAR.

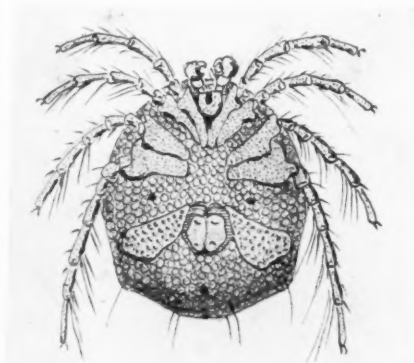

FIGURE 223. *Arrhenurus insulanus* Koen. Ventral surface of the female × 19.

FIGURE 224. The genital area of the specimen seen in Figure 223 × 40.

A PARASITIC ALGA.—I have received through a friend at the Quekett Microscopical Club some portions of leaves of *Arisarum vulgare* attacked by the parasitic alga *Phyllosiphon arisari*. On holding a piece of the dried leaf up to the light, it is noticed that the chlorophyll, in the worst cases, is destroyed in the neighbourhood of the alga, leaving a colorless and partially transparent spot, in which, after preparation and examination under the microscope, it is evident that the internal structure is broken up, little indeed remaining but the upper and lower cuticles—even they being in a more or less disorganized condition — and the vascular bundles. Between the cuticles the filaments of the alga can be seen ramifying, radiating from what is probably the centre of infection. It is noticeable that where a vascular bundle crosses the leaf, the filaments are checked in their progress (see Figure 225 A). They proceed chiefly in the intercellular spaces of the spongy parenchyma, absorbing the protoplasm and chlorophyll on the way, at last destroying the cells also. The alga consists of much branched tubes, from about 25 to 40μ diameter; they have firm walls and are filled with protoplasm, in which are very numerous small oval green chloroplasts about 2½μ in their longest diameter; many nuclei are present. From the fact that the plant possesses chlorophyll of its own in abundance, it may be concluded that it is only partially parasitic, but it no doubt obtains its water, mineral and nitrogenous elements from the host, although most likely it is able to fix CO_2 for its requirements. The characteristic feature is that, although of very considerable length the tubes have no cross walls; each has a continuous cavity for its whole length, and may be looked upon, therefore, as one cell only, and the plant notwithstanding its size is unicellular. This peculiarity has caused it to be classed with the *Siphoneae*. The very common alga *Vaucheria* belonging to the order has the same feature and indeed *Phyllosiphon* closely resembles a delicate specimen of *Vaucheria*. Just as in that plant too, owing to the absence of dividing walls, if a filament is cut or injured, the contents escape, leaving nothing but the empty tubular wall, of which several examples may be seen in the figure. I have not been able to find out anything respecting its reproduction, and in my specimens, of course somewhat suffering from the drying, there is no sign of anything of the kind,

nor any appearance of a tendency in the filaments to emerge on the surface of the leaf, as would be expected as a preliminary to the process. The family—Phyllosiphonaceae—is mostly tropical and several species are known as occurring on the leaves of various hosts, but the one under consideration is found only in the North of Italy, and the South of France. Figure 225 A is a portion of leaf, slightly magnified, showing the course of the filaments, in B some are dissected out, giving their general appearance; at the bottom is a piece of the partially disorganized lower cuticle with the parasite spreading from the remains of the leaf cells, × about fifty.

JAS. BURTON.

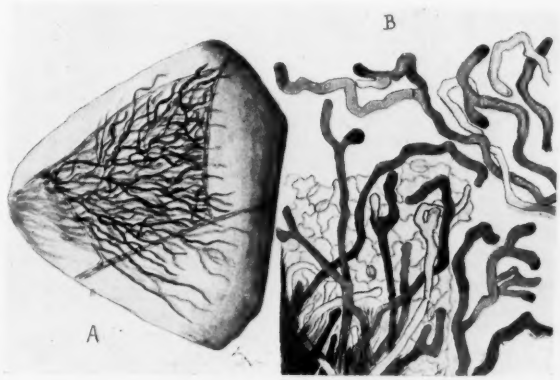

FIGURE 225.

A. Portion of a leaf infected with *Phyllosiphon*, magnified.
B. Filaments dissected out × 50 approximately.

ROYAL MICROSCOPICAL SOCIETY. — March 20th, 1912, Edward Heron-Allen, Esq., F.L.S., Vice-President, in the chair.—Mr. C. F. Rousselet described a Lieberkühn Microscope which had been presented by Mr. Alpheus Smith. Lieberkühn devised this form of microscope about 1738; it was intended principally for viewing opaque objects which were illuminated by a silver concave speculum in the centre of which was mounted a bi-convex lens. The combination of a lens and reflector was invented by Descartes in 1637, but it remained for Lieberkühn, 100 years later, to apply it in a convenient and serviceable form. The reflector is known as a "Lieberkühn" and is used at the present day. Mr. Rousselet also described two old microscopes lent for exhibition by Mr. T. H. Court. The first, a small portable simple microscope, signed I. Cuff, was probably made about 1750. The pillar is inclinable and is mounted excentrically upon a thin oval brass plate upon which it can be rotated to give stability to the instrument in different positions. It has a fine adjustment of the John Marshall type to the lens-holder. There is a concave mirror, which with the lens-holder, stage and oval foot are hinged so that they can be folded up. It seems probable that this instrument may have been the parent model of Ellis's Aquatic Microscope. The second microscope was by Watkins and Smith, who were in partnership from 1765 to 1775, which circumstance fixes the date of the instrument. The general features are similar to those of a microscope made entirely of silver by François Watkins that was exhibited at a Meeting of the Society in November, 1907, the date of which was about 1754. Watkins at this date was "Optician to their Royal Highnesses Prince and Princess of Wales, at Sir Isaac Newton's Head, Charing Cross." This latter microscope was wanting in rigidity, but the model now exhibited was more substantially made and was free from vibration. The fine-adjustment in the silver microscope was absent and a strong rack-and-pinion coarse adjustment applied to the stage was substituted. There are seven powers mounted on a disc between two brass plates. The instrument is inclinable and can be used as a simple or with a body and eye-piece, as a compound microscope. The mirror is double, plane and concave.

Mr. Conrad Beck exhibited the "Focostat Lens," described below.

Mr. E. J. Sheppard exhibited two slides. The first was a vertical section through the four upper incisors of a kitten about six days before birth, the section passed through nearly an equal plane in each tooth. Mr. Sheppard also described the method of staining adopted. The second slide showed the second maturation division in the ovum of a mouse prior to its leaving the ovary.

Mr. C. F. Rousselet then described four Rotifera from the Devil's Lake, a large brackish-water lake in North Dakota, the point of interest being that all four species lived in brackish water only. One, *Pedalion fennicum*, was first found in Finland, another was a new species, *Brachionus spatiosus*, the third *Brachionus satanicus* Rousselet, known only from this locality, and the fourth was *Asplanchna silvestrii* Doday, E. P., showing dimorphism in the female.

Mr. F. Enock gave a lecture on "Fairy Flies and their Hosts." His interest in these minute flies (Mymaridae) was excited by seeing one that was exhibited by the late Frederick Fitch at a Conversazione given by the Society in 1875 or 1876. At that time the only illustration known was that of a very minute insect drawn in 1797 by Dr. Grey, of the Royal Society, and published in the Linnean Society's Transactions. Up to four years ago Mr. Enock had worked on the subject alone. He was then joined by Mr. Chas. Waterhouse, of the Natural History Museum. The interesting fact was that the eggs of the Mymaridae are deposited in the eggs of destructive flies. The lecture was illustrated by many beautiful slides prepared by Mr. Enock, including a series of photomicrographs illustrating the life history of the fly from the time its egg was deposited in its host.

THE NEW FOCOSTAT LENS.—The Focostat lens is the invention of Mr. T. H. Hiscott, a member of the Royal Microscopical Society, who devised it for his own use in the field. Those who know the difficulty of dissecting a flower under a high power lens will realise the great advantage of this contrivance. Even if the flower can be held by some means while the lens occupies one hand and a needle or scalpel the other, the slightest motion puts the lens out of focus.

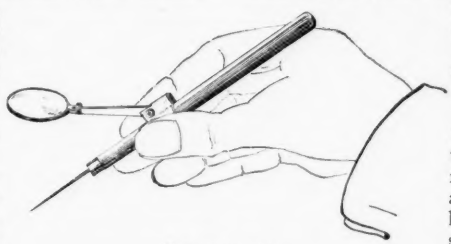

FIGURE 226.
Hiscott's "Focostat Lens."

In the invention under consideration (see Figure 226) the lens is carried on the needle itself. It is focused once for all on the point of the instrument and follows every movement. The lens has a magnifying power of about seven diameters. It can be slid along the handle of the knife or needle and adjusted to the angle at which the observer is in the habit of holding his hand. It has proved to be most useful in zoölogical and botanical dissections and for fine drawings with a mapping pen, while many other uses will suggest themselves.

Messrs. R. & J. Beck, of 68, Cornhill, are putting the Focostat lens on the market together with dissecting knives and needles, mapping pens, and retouching pencils with circular handles on which the Focostat is interchangeable.

Mr. Hiscott is greatly to be congratulated upon his extremely useful invention.

THE PSEUDOPODIA OF DIATOMS. — Several observers, noticeably Mr. Grenfell and Professor Van Heurck, have discovered the appearance of projections from diatoms particularly in the genus *Coscinodiscus*, but it has been argued successfully up to the present that they are not parts of the diatom itself and are possibly parasites. At the meeting of the Royal Microscopical Society, held on March

20th, Mr. J. D. Siddall demonstrated the presence of what he called pseudopodia in *Coscinodiscus heliozoides* spen, by means of powerful illumination and a black background. In his paper on the life-history of the diatom which was sent to him alive by Mr. Thomas Shepherd, of Bournemouth, Mr. Siddall described his observations of the movements of the *Coscinodiscus* by means of the filaments of protoplasm, which differ from the pseudopodia of the Rhizopodia in that no circulation of the protoplasm can be made out. It was the general opinion of those present that Mr. Siddall had made out a good case, and he showed not only living specimens but others mounted in a mixture of formalin in sea water. There are more than forty of the pseudopodia, and the diatom is held up from the surface on which it is resting by means of them as if, as Mr. Siddall says, it was walking on stilts.

CORRECTION.—In the note—An attractive "Common object," pages 153-4 "KNOWLEDGE" for April, instead of as at present, the last sentence should read:—The figure was drawn from a specimen treated in this way; the *paraphyses* and *asci* with contained spores A × 265 and the separate spores B × 445.

ORNITHOLOGY.

By HUGH BOYD WATT, M.B.O.U.

MARKED BIRDS RECOVERED.—The current number (April) of *British Birds* contains (pages 312-318) a number of further returns, from which the following are taken, viz:—

	MARKED.	RECOVERED.
Cormorant (*Phalacrocorax carbo*)... ...	Scilly Isles, 22nd May, 1911 ...	Finistère, France, 26th December, 1911
Lapwings (*Vanellus vulgaris*), two birds ...	Stirlingshire, 5th June, 1911 ...	Queen's Co., 24th December, 1911 and Co. Clare, 5th February, 1912
,, ,, ,, ...	Peeblesshire, 24th May, 1911 ...	Vendée, France, 30th January, 1912
Black-headed Gull (*Larus ridibundus*) ...	Yorkshire, 1st July, 1911 ...	Flores, Azores, 11th February, 1912
,, ,, ,, ,, ...	Schleswig, 24th June, 1911 ...	Yorkshire, 15th January, 1912
,, ,, ,, ,, ...	Rossitten, 18th July, 1911 ...	Barbados, W. Indies, November, 1911

The editor, remarking on the Azores and Barbados records of the last-named species, says that it is said to be a common visitor to the Azores, and must come from Europe. He conjectures that, that being so, the Barbados bird probably reached there by natural means and may have been tempted far out of its normal course by following a ship.

FIRST RECORD OF THE HOOPOE IN ENGLAND.—Mr. W. H. Mullens has recently pointed out that although the credit of including this bird (*Upupa epops*) in the British list is generally attributed to Christopher Merrett (1666), it of right belongs to an earlier writer. Thomas Muffett, in his "Healths Improvement," published in 1655, says that although "Houpes were not thought . . . to be found in England, yet I saw Mr. Serjeant Goodrons kill of them in Charingdon Park." (*British Birds* for March, 1912, Volume V., pages 276 and 270).

SALE OF THE EGGS OF THE GREAT AUK.—On Wednesday, April 17th, two eggs of the Great Auk were sold at Stevens's. Neither of them was a particularly good specimen, and the prices realised were not, therefore, very high. There is rather a romantic story attached to the first, as it is one of the two which were bought by a boy at a sale in Kent in 1894 for 36s., and which within a month brought him in something more than £400. We learn from Mr. Thomas Parkin's paper on "The Great Auk," which is noticed on page 203, that this egg was sold on April 24th, 1894, to Mr. Henry Munt for £183 15s., and on June 20th, 1900, Mr. James Gardner bought it for the late Sir Greville Smyth for £189. This time it changed hands for one hundred and fifty guineas. The other egg, which fetched ten guineas less, was purchased many years ago with a number of sea-birds' eggs by the late Sir Greville Smyth, but nothing is known of its previous history. Both the eggs were knocked down to Mr. Rowland Ward. Afterwards a number of painted models of celebrated eggs, from the collection of Mr. E. Bidwell, were sold, and fetched prices varying from £2 5s. to £4 10s.

THE DRESSER COLLECTIONS.—The University of Manchester has this winter had transferred to its Museum the very fine and extensive collection of eggs of Palaearctic birds made by Mr. H. E. Dresser, and also the library of books on ornithology and oölogy, The same Museum received the Dresser collection of birds more than twelve years ago, and is thus thoroughly equipped with the most authentic material for the study of European and eastern Palaearctic birds. Painstaking research, continued over a long series of years, was taken in making the collections and only carefully authenticated specimens have been admitted, and most of them have a full history. The great English ornithologist who made the collections will be commemorated by these, as, along with the library, they are being kept together, and named the "Dresser Collection." This will be restricted to Palaearctic ornithology and oölogy, the field of Mr. Dresser's life-long and authoritative work.

EXTREMES OF SIZE IN BIRDS.—In *The American Naturalist* for March, 1912, Dr. A. W. Henn writes on this subject with reference to vertebrates generally. Of birds he says that the smallest is a Humming Bird (*Calypte helenae*) from Cuba, total length two and a-quarter inches (fifty-seven millimetres), but that several other species of Hummers, such as the Jamaican *Melisuga minima*, which measures two and nine-sixteenth inches (sixty-five millimetres) are only slightly larger. No mention is made by Dr. Henn of the biggest bird, but this amongst living species is the Ostrich which, however, is greatly exceeded by the extinct New Zealand Moa (*Dinornis*). The most massively built of all birds was probably the extinct Patagonian Seriema or Cariama (*Phororhachos*), with a skull approaching that of a horse in size; but in massiveness of limb this species is exceeded by some of the great birds of the genus *Aepyornis* from Madagascar, the remains of which are conjectured to have given rise to the legend of the Roc. It is not easy to say which is the largest flying bird, as wing expanse scarcely affords a true criterion, but the usual claimants for this are the Giant Albatross (*Diomedea exulans*) and the Chilian and Californian Condors (*The Field*, April 13th, 1912, page 744). Amongst living British birds the smallest in size is the Gold-crested Wren (*Regulus cristatus*), about three and a-half inches in length, and the largest is the Whooper or Wild Swan (*Cygnus musicus*), measuring five feet. Between this and the next biggest and better known birds is a considerable difference, these being the Golden Eagle, averaging thirty-three to thirty-five inches, the Gannet, thirty-three inches, and the Cormorant, thirty-two inches in length respectively.

BIRDS AND GENETICS.—In the course of lectures this winter by Mr. W. Bateson at the Royal Institution, London, on "Studies in Genetics," birds, along with other animals, were cited to illustrate our ignorance of the factors which control variations in animals. What (asked Mr. Bateson) was the cause of the difference between the Black Crow and the

Hooded Crow, between each of which there was an intermediate form, possibly a hybrid? If a line were drawn from Glasgow to the Adriatic Sea the Black Crow would be found on the east of it and the Hooded Crow on the west. No answer had yet been found for their differentiation. More puzzling still was that birds of exactly the same species were found in the northern half of India and not sighted again till Ceylon was reached, a slightly different species separating the two. The variants never passed over the border line, and yet were within "crowing distance" of each other. The Tree Sparrow and the House Sparrow differed in their markings, and the male of one kind could be distinguished from the female of the other kind only by dissection. In America there were to be found male birds which moulted to the colour of the female. These differences and distinctions still await reasoned explanations.

PHOTOGRAPHY.

By EDGAR SENIOR.

RADIO-ACTIVE BODIES.—Interesting as the results brought about by the action of ultra-violet rays are, especially in the light of their practical bearing upon every-day work, there are other instances of photographic effects resulting from invisible radiations, which may claim our attention equally well. First of importance among these stands the discovery made by M. Henri Becquerel in 1896, that the double sulphate of uranium and potassium, and also the metal uranium itself, emitted rays that were capable of forming impressions upon photographic plates in total darkness. It was at first thought that the cause might be due to phosphorescence, as uranic salts possess this property when exposed to ultra-violet light (although only for a very limited period) but as uranous salts "which are non-phosphorescent" were found to be equally active the above explanation became untenable. That the action was not due to stored up energy from previous exposure to sunlight was proved by the fact that crystals deposited from solutions in darkness possessed exactly the same properties as those previously experimented with, and which had been exposed to light. Further experiments pointing to the absence of evidence of either reflection, refraction or polarization, went to show that the effects could not be due to ether waves of the nature of light. The posing problem was, however, finally solved, when it was discovered that those rays which act photographically can be deflected by a magnet, and that their behaviour in all respects was similar to cathode rays, which consist of streams of negatively-charged particles projected with great velocity. In honour of the discoverer these rays have been called Becquerel rays, but the term radio-active is now generally applied to such bodies which belong to a class of substances of which uranium, thorium, radium and their compounds form part, and which possess the property of spontaneously emitting radiations which are capable of passing through substances opaque to ordinary light, such as metal plates, and the still further characteristic of being able to impress a photographic plate in the dark, and of discharging electrified bodies. It is also found that radium, which is a strongly radio-active body, is able to cause marked fluorescence and phosphorescence in some bodies placed near it. The remarkable property of radio-active bodies is their power of being able to continuously radiate energy, and at a constant rate, without "so far as is known" any external exciting cause. As already stated thorium belongs to this class, and in Figure 227 is shown a portion of an incandescent gas mantle the photograph of which was taken in total darkness by means of the radiations given off by the thorium, which was present in small quantity in the mantle. The photographic plate from which the print was made was enclosed in an orange paper envelope, the mantle was laid upon this, and the whole enclosed in a tin box which was placed away in a cupboard for three weeks. The image was then developed, with the result shown.

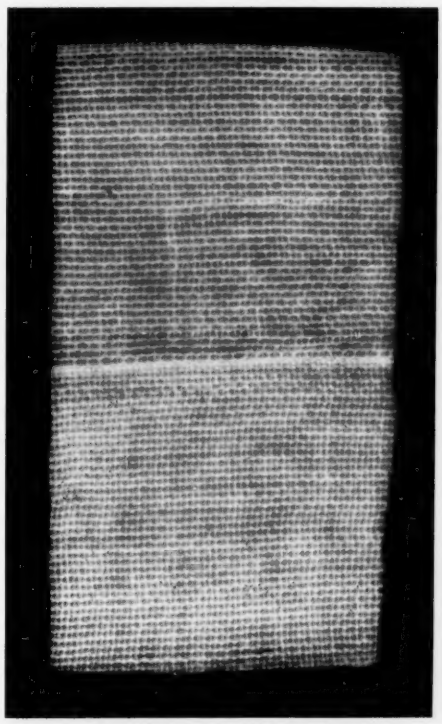

FIGURE 227. Part of an incandescent gas mantle, photographed in total darkness.

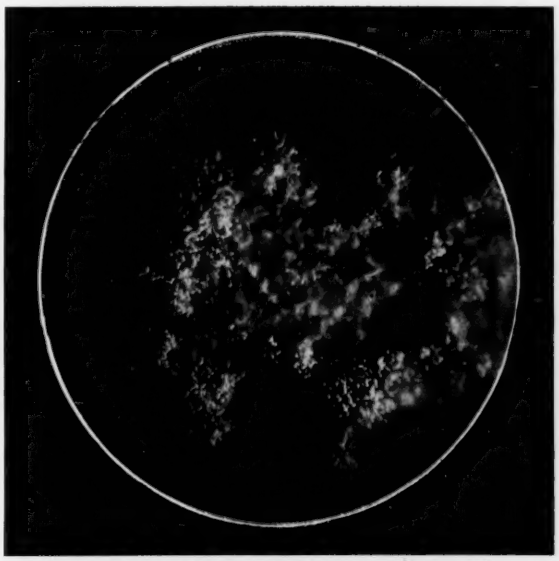

FIGURE 228. A Fungus *(Penicillium glaucum)* on a gelatine photographic film, magnified.

THE EFFECTS OF DAMP ON PHOTOGRAPHS. — It has lately been found that a good many photographs and mounts are affected with mildew, although kept under the same conditions under which they had previously shown no signs of any such trouble. The cause is no doubt due to the excessive amount of wet weather experienced some time back. The form of the fungus (for such it is) is of the nature of that which produces common mould and is known by the name of *Penicillium glaucum*. This plant may be found on the surface of jellies and preserves, and consists of a mass of filaments serving as its base, and from the surface of which rise up thin stems bearing at their extremity a number of minute cells which are the spores or reproduction organs. These plant-like threads thrive in damp atmospheres of cellars or rooms generally, and gelatine forms a good medium for their propagation. They form beautiful

objects for the microscope, especially when illuminated by reflected light, but are scarcely satisfactory as an addition to the photograph, to say nothing of the effect they may have on the print itself. Some idea of their appearance may be gained from the illustration (Figure 228), which is a photomicrograph taken by reflected light. The little white dots are the spores. The want of definition in parts is due to differences of distance of the image planes, for although a narrow angle objective was employed in order to obtain depth of definition, the distances apart of different parts of the object were too great. When this fungus was removed from the print by brushing or careful rubbing with a piece of cotton wool, the picture was in many cases found to be uninjured; in others spots remained. Far more serious is that effect of damp which causes a fading of the print generally, brought about most probably by decomposition products of the mountant itself in many cases, aided by small quantities of the fixing agent remaining in the print. Obviously the best way of protecting prints from the troubles arising from mildew is to keep them as far as possible in a dry and pure atmosphere, as the fungus of which we have been writing flourishes in a damp and unwholesome one.

EXPOSURE TABLE FOR MAY.—The calculations are made with the actinograph for plates of speed 200 H and D, the subject a near one, and lens aperture F16.

Day of the Month.	Condition of the Light.	Time of Day.			
		11 a.m. to 1 p.m.	10 and 2	3 p.m.	Remarks.
May 1st	Bright	·08 sec.	·1 sec.	·12 sec.	If the subject be a general open landscape take half the exposures given here.
,, ,,	Dull	·2 ,,	·21 ,,	·24 ,,	
May 15th	Bright	·07 sec.	·09 sec.	·1 sec.	
,, ,,	Dull	·18 ,,	·19 ,,	·2 ,,	
May 31st	Bright	·06 sec.	·08 sec.	·1 sec.	
,, ,,	Dull	·16 ,,	·18 ,,	·2 ,,	

PHYSICS.

By ALFRED C. G. EGERTON, B.Sc.

GLOW IN HYDROGEN.—Hertz had observed a glow in hydrogen after the passage of an electric discharge from a Leyden jar, the hydrogen being at a pressure of one hundred millimetres of mercury. Professor Strutt, in continuation of his work on the glow produced by electric discharges in various gases, which has led to such important results in the case of nitrogen, has investigated this glow in hydrogen. He finds that it is due probably to traces of sulphuretted hydrogen, which are decomposed by the discharge, and subsequently the sulphur and hydrogen re-combine and in doing so emit a bluish light.

THALLIUM FLAME.—Dr. Lowry has described an ingenious method of obtaining the monochromatic green thallium flame, for use in polarimetric measurements. Thallium chloride is heated in a silica bulb, which is connected by a metal tube to the tube of a Bunsen burner and passes up within it, terminating in a vertical jet. A current of oxygen passes over the heated thallium chloride and carries the vapour over into the flame, giving a steady lasting colour to it.

G. E. Gibson has heated metallic thallium to 1300°C in an evacuated quartz tube. The vapour emits the green line strongly, and it has been shown that this is a true temperature radiation and not merely a luminescence effect. The light from the tube was focused on the slit of a spectroscope: after the introduction of the cold tube containing the thallium, the dark thallium line crosses the continuous spectrum of the radiation from the furnace, but this gets fainter and disappears as the temperature of the thallium vapour reaches that of the furnace. In three minutes the black absorption line has disappeared altogether with the temperature of the furnace standing at 1450°, and if the tube is suddenly removed from the furnace, the thallium line appears bright against a dark background. It is not easy to obtain direct evidence of the production of bright line spectra by the effect of temperature alone, but this experiment shows the effect very beautifully. Professor Wood has described an experiment, already mentioned in these columns, in which iodine is dropped into a hot quartz bulb, the vapour of the iodine giving out a reddish light and making the quartz bulb appear red hot.

The nature of the light emitted by a flame depends on the nature of the flame itself. A. Harnack has investigated the spectra of various metals in the oxyhydrogen flame, and has compared them with the spectra obtained in the hydrogen-chlorine flame, which has a temperature of 2300°. Only chloride bands are common to both flames: thus the copper chloride bands in the oxyhydrogen flame would correspond to the copper bands in the hydrogen-chlorine flame. The hydrogen-chlorine flame spectra of the metals gives rise to comparatively few lines. The chloride band spectra are more fully developed in the hydrogen-chlorine flame than in the oxyhydrogen flame in which the chlorides of the metals are burnt.

RADIOACTIVITY.—There is no well-established case where radioactivity is caused by artificial means. In speaking of flames we may refer to the work of Carter, published in *The Philosophical Magazine* of November last in this connection. Searching tests have been made to find whether any β rays are emitted when large changes of energy occur during the combustion of substances giving rise to high temperature flames, but no positive result has been obtained. Special precautions had to be taken during these experiments to prevent effects of temperature on the electroscope used for detecting the presence of the rays. In the flame itself enormous ionisation is occurring—and no doubt electrons are set free within the flame, but these are still part of the processes going on within the flame, and no electrons are projected out with great velocity, and lost to the body projecting them, as in radioactive processes. The author investigated the radiation from the electric arc, the spark, and the oxyacetylene flame to search for an effect, but none was obtained.

Mention may be made here of a negative result obtained by Dr. J. Vincent; he investigated whether the period of radioactive change could be altered in any way by the application of powerful electric fields. No change of any kind was observed. The spontaneous processes occurring within the atom giving rise to radioactivity are still out of human control, but every week adds knowledge to the nature of these processes. Professor Rutherford's, and his collaborators', work on the counting of the α particles emitted from radioactive substances by scintillations produced on zinc sulphide screens, and the scattering of α and β particles by various substances is giving rise to further knowledge of the internal structure of the atom.

The α rays from different substances are characterised by their range or the average distance through which they travel in air at the standard temperature and pressure—0° C. and seven hundred and sixty millimetres. Geiger and Nuttall have investigated the ranges of α particles from uranium and thorium and have found that they are proportional to the transformation constants—the constants of the time of change from the one radioactive substance into its successor—and since no α ray products are known of very short range the explanation is probably to be sought here, for the life of a substance emitting α rays of one centimetre range would be so long that its period of change would be very slow and its activity would escape detection.

FOG.—Dr. Aitken has shown that the sun causes the production of fog when a light wind brings an impure and damp air into the neighbourhood; while when the wind comes from a pure direction, the sun causes no fog to appear. He has come to the conclusion that the fogs are due to the action of the sun on the sulphur products in the air produced by the combustion of coal, and also to the sunshine forming hydrogen peroxide in the air. In this way particles are formed which can condense water vapour in air unsaturated with moisture.

The melting of an iceberg is accompanied—especially in calm weather—with the production of fog, because the air in the neighbourhood soon becomes supersaturated with moisture, while the low temperature causes deposition of this moisture. For this reason, and also owing to the peculiar cloud-like aspect of an iceberg at night, the iceberg is not easily visible. The danger is increased by the fact that the extent of the iceberg may be far greater under water than it appears to be above: the action of the waves help to cause a shelving away of the berg near the surface of the water. The actual volume of the ice above water always has a fixed ratio to that below, about as one is to eight. The detection of icebergs becomes a matter of great importance to shipping—as has been so deplorably made manifest recently by the disaster to the "Titanic." The method by means of which the whereabouts of an iceberg might be established cannot be numerous, for the reason that the ice is much the same substance as water: one could suggest, perhaps, a few possible methods of detection—temperature of the water, or saltness of the water in the neighbourhood of the iceberg. However, in a big pack or icefield, the alteration of such properties of the sea water would not be sufficiently great to be of practical value. It would appear more practical to provide every ship with some form of search-light which could be made to automatically pass a very intense beam of yellow light across the course of the ship from side to side. The yellower the light the more fog-resisting the beam. This suggestion would seem the most practical method of combating a danger which can have such appalling consequences. The lighthouse is at any rate some use in a fog.

EMISSION OF ELECTRONS DURING CHEMICAL CHANGE.—Lavoisier's principle that "matter is indestructible" and that "during a chemical change there is no loss or gain of matter" has been proved by Landolt to hold, so far as the most accurate balance can settle the question. But since heat is often evolved during such a change and since the force of chemical affinity appears to be of an electrical nature, it is quite possible that the energy changes entail loss of electrons—which would be quite undetectable by the change in weight of the reacting substances. Professor Haber has recently made experiments on amalgams of sodium and the other alkali metals and finds that in an exhausted space containing small quantities of reacting gases, such as bromine or phosgene gas, the metal acquires a positive charge and negatively charged electrons are set free. Similar experiments with quinine salts showed that they absorb water and in doing so tend, owing to discharge of negative electrons, to ionise the air. Gases, evolved by the action of acids on metals, Sir J. J. Thomson showed to be ionised and his interesting results were published in a book entitled the "Discharge of Electricity through Gases." Such experiments lead to the questions "To what extent is the atom of an element capable of undergoing change in electrical structure before it ceases to behave in its own distinct manner?" and "To what extent is the atomic mass of an element an invariable quantity?" Does the "atomic mass vary with the temperature?"

EXPLOSIONS.—An interesting study of the radiation during explosions forming carbon dioxide and water vapour has been recently published in the October *Philosophical Transactions of the Royal Society*, by W. T. David. The results appear to show that when an explosion occurs the vibratory energy is a maximum before the maximum pressure is attained and, therefore, before the mixture attains the maximum temperature. Hence it is probable that a considerable part of the energy of combination goes to set up internal vibrations of the carbon dioxide and steam molecules; part of this energy is lost as radiation and part is transformed into rotational energy and translational energy, the latter causing increase of pressure of the gases. The work of Professor Dixon and also of Professor Hopkinson, on the propagation of explosions is highly interesting and should be consulted by those who wish to follow up the matter.

ZOÖLOGY.

By PROFESSOR J. ARTHUR THOMSON, M.A.

INTELLIGENCE OF FISHES.—There are not many precise data in regard to the intelligence of fishes. Some observers say they can be trained a little; others, like Edinger, deny them even memory. It seems that the brain, of bony fishes in particular, remains at a low grade. M. Oxner has recently made some interesting observations at the Oceanographical Museum at Monaco with a fish called *Coris julis*. When he disguised the hook perfectly he caught the same fish as often as he pleased. But that only proved that the disguise was perfect and that the fish was appetised.

In another set of experiments he used an equally well hidden hook, but placed a piece of red paper on the gut-line a couple of inches above it. For the first week the fish (an inexperienced one, of course) remained indifferent; on the eighth, ninth, tenth and eleventh days it took the bait; on the twelfth day it refused the bait till the red paper was removed; on the thirteenth, fourteenth and fifteenth days it refused the bait with the red paper, though it examined it carefully; on the sixteenth day and on the following six days it began by snapping at the red paper, and then turning to the hook bit off the bait in small scraps, without any hurry, and with a thousand precautions.

It looks as if an association was here established between the pain of being hooked and the red paper, and as if the latter became a warning advertisement, inhibiting the instinctive attraction to swallow the bait, literally putting a drag on the animal's movements. Gradually, however, the fish regained liberty of action, it disregarded the taboo, it very deliberately experimented with the bait, it succeeded, and we say that it "understood." Apprendre, M. Oxner says, n'est que la série successive des essais réussis.

RESOURCES OF THE SEA.—With the great resources of the sea, such as fishes, whales, seals, turtles and crustaceans everyone is familiar, but the miscellaneous minor treasures are less appreciated. It is interesting, therefore, to take a concrete case, and we may refer to Alvin Seale's account of the miscellaneous marine products of the Philippine Islands. There are the trepangs or sea-cucumbers, a staple food of all Oriental people; Sharks' fins are dried, cured, and exported to China as a basis for soup; there is the window-shell (*Placuma placenta*) the right valve of which is used intact instead of glass in most of the buildings in the city of Manila; there are several Gasteropods, such as *Trochus niloticus* and *Turbo marmoratus*, whose shells are used for button-making; there are various corals (including apparently the precious coral) useful for decorative purposes; the black antipatharian is used for making canes; there are several edible seaweeds; and there are sea-snakes whose skins make beautiful leather.

PURIFICATION OF OYSTERS.—Fabre-Domergue continues his important experiments on the purification of oysters. He has tried keeping them in filtered artificial sea-water, introducing a sand-filter into a closed circulation through a series of tanks. He has obtained excellent results not only as regards purification, but as regards the vitality and flavour of the oysters.

EXPERIMENTAL REDUCTION OF WINGS.—J. Dewitz returns to some very interesting experiments which he made a dozen years ago on wasps (*Polistes*). He placed the nests for forty-eight hours in a refrigerator and found that this had the result of hindering the development of the wings. Similarly, with the pupae of flies (*Calliphora*), exposure to cold resulted in defective wings. Extending these experiments, Dewitz finds that chrysalids with shortened wings result when the caterpillars of *Porthesia chrysorrhoea*, just about to undergo metamorphosis, are placed in an atmosphere containing hydrocyanic acid. It seems that a ferment (tyrosinase), which occurs diffusely in the larva, is localised in the wings of the pupa, and the author suggests that the artificial conditions noted above act prejudicially on the ferment. Perhaps the

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diminution of pigment in the eye of cave-insects is also bound up with a reduction of ferments.

MASSES OF WATER-WORMS.—Professor George H. Carpenter reports an interesting case of inconvenience caused by water-worms. A farm drain, six inches by four inches in section, was found to be completely blocked for a distance of three or four feet by a mass of minute Tubificid worm, which were identified by Mr. R. Southern as *Limnodrilus udekemianus* Claparède. These worms can live in water or in mud, and have the habit of forming large tangled masses, which accumulate slowly, and can offer great resistance to strain.

DISCHARGE OF CUVIERIAN ORGANS.—Mr. G. R. Mines has studied the mode of discharge of the Cuvierian organs of *Holothuria nigra*. They are white conical bodies, expelled posteriorly when the sea-cucumber is irritated. They remain attached by their bases to the animal, but elongate into long sticky tubes which are disconnected. Undischarged Cuvierian organs removed from the Holothurian can be made to elongate by injecting them with sea-water or other fluid. The natural discharge is always preceded and accompanied by a rise in the pressure within the body. It seems, then, that the elongation is due to internal fluid pressure, and not to any intrinsic activity of the tubes.

TENACITY OF LIFE IN CATERPILLARS.—While the larvae of some insects, such as fleas, are delicate and readily killed, it is very much the reverse with others. L. Bordas finds a good example in the Potato Caterpillar (*Phtorimaea operculella*), which is notably difficult to kill. He notes, for instance, that immersion in alcohol (70°) for six to eight hours left them able to contract the body, and to move the head and limbs and mandibles. The power of resistance is referred to the structure of the respiratory system (stigmata and tracheae), but one would like to have more precise explanation.

POLYDACTYLY. — In reporting two instances of supernumerary thumbs, which are not so common as supernumerary little fingers, Dr. J. D. Fiddes refers to the theory or aetiology of this peculiar condition. The case may be stated thus: (1) Where the extra thumb is a sixth digit there is no use at all in dragging in the idea of a reversion to a long-lost ancestor with more than five digits. There is no evidence of there ever having been any creature with more than five digits. (2) There are many cases known where polydactyly has run in a family, generation after generation. A tendency to a duplication of a thumb or little finger seems to be sometimes hereditary. In such cases the condition is often symmetrical, often involving all the four extremities, and is often associated with other inborn peculiarities. (3) A case of polydactyly cropping up without any hereditary precedent for it may be due to a germinal variation similar to that which started the hereditary series already referred to. (4) Finally, the polydactyly may be modificational rather than variational. That is to say it may be due to "a developmental accident"—to an abnormal amniotic band pressing upon the digital bud and splitting it. Such cases of "schistodactyly" are asymmetrical.

LENGTH OF ALIMENTARY CANAL AND LENGTH OF BODY.—A. Magnan has made careful measurements of the length of the food canal in thirty species of mammals (two hundred and eighty specimens), and finds that its ratio to the length of the body is least in the carnivorous forms, greatest in the vegetarians, and intermediate in those that may be called omnivorous. The same general statement holds true of birds, and is to be interpreted as a physiological adaptation to the digestibility of the various types of food. It applies not merely to the length of the food canal, but to its internal surface, though the patient measurer has not yet taken the villi into account.

HYBRIDISING SEA-URCHINS.—Professor E. W. MacBride, working at the Marine Biological Station at Millport on the Clyde, has succeeded in fertilising the eggs of the common heart-urchin (*Echinocardium cordatum*) with the sperms of *Echinus esculentus* and in rearing the hybrid larvae for eight or nine days. Previous workers on similar lines have, in most cases, found that the hybrid larvae of sea-urchins were of the maternal type, but MacBride finds in his case that the larvae show paternal characters as well. The case is of great interest on this account and also because the two genera are so far apart. The author points out that *Echinus* and *Echinocardium* have been distinct since the beginning of the Secondary epoch, and that their common ancestor could not have lived later than a period which a moderate estimate would place at twenty million years ago; yet the germ-cells of the two types will commingle so as to produce a hybrid in which both paternal and maternal characters are represented.

STONYHURST COLLEGE OBSERVATORY.

By FRANK C. DENNETT.

THE report of this busy observatory for 1911, by Rev. W. Sidgreaves, S.J., F.R.A.S., its Director, is just to hand. The year's mean barometic pressure was only ·053 inch above the average of the last sixty-four years. Every monthly mean, excepting November and December, was above its average, January showing the highest and December the lowest of the year. January had a rainfall nearly two and a half inches short of its average, whilst December was over two and a half inches in excess. The latter was the wettest month of the year, rain falling on twenty-seven days, but it was warm, the temperature being 4°·2 above its average. February was another very wet month being 2·68 inches in excess of the average. July had a rainfall over three inches below its average, receiving less than a quarter of its usual supply. July was also remarkable in having bright sunshine for eighty-two hours in excess of the monthly average, and sixteen hours above all previous records. The mean temperature of August was half a degree higher than that of July, and was the highest on record for the month, and 4°·7 above the average. The mean temperature of the year, 48°·6 is 1°·7 above the average. April 19th had a wind velocity of fifty-three miles per hour, a record for April. The decrease in the daily spot area upon the Sun, and the mean daily range of the magnetic declination (in minutes of the arc), is well shown, as compared with previous years.

Year	1906	1907	1908	1909	1910	1911
Spot area	4·8	5·8	4·6	3·8	1·8	0·3
Declination range ...	13·9	14·7	14·1	13·5	14·5	12·6

The unit of the spot area is equal to one-fivethousandth part of the visible disc.

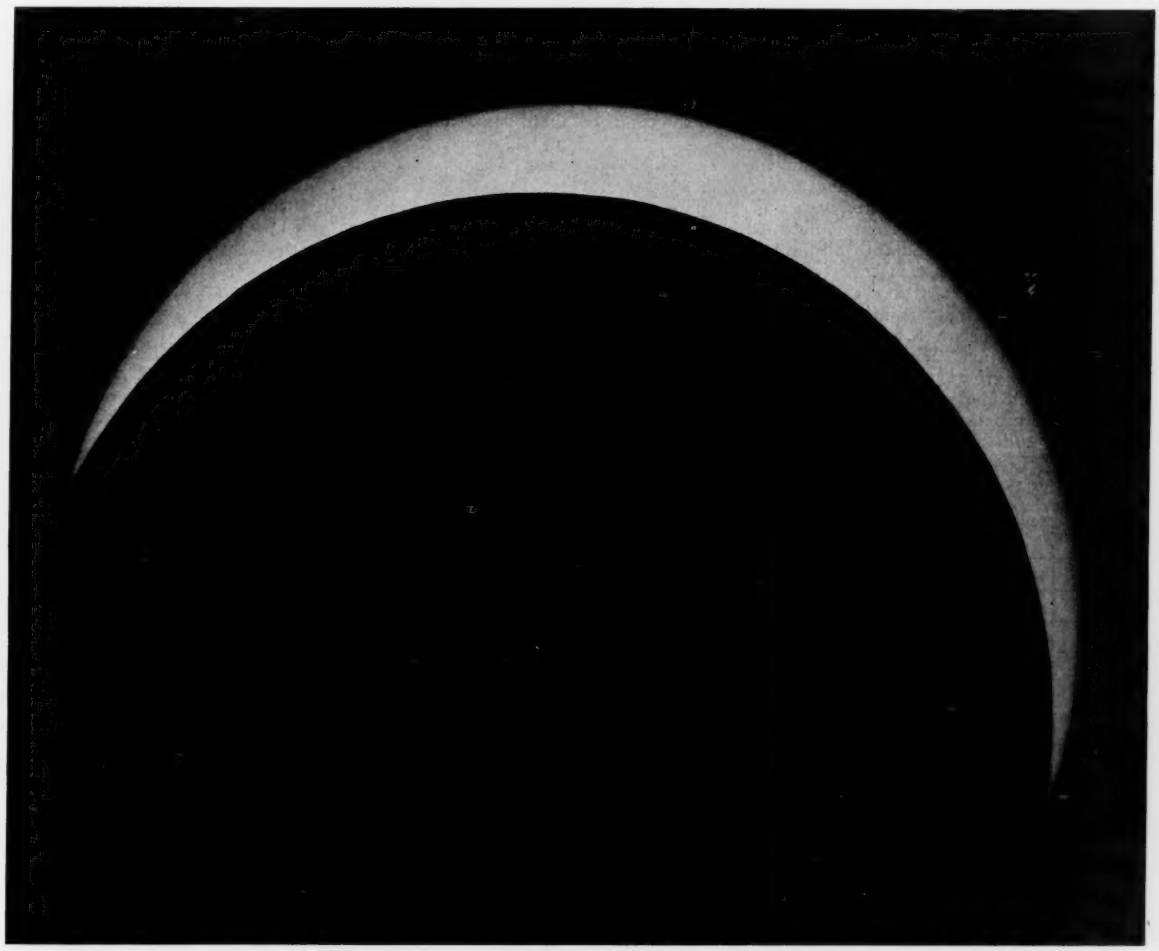
The monthly means indicate the solar minimum in December. [But this may perhaps be a little premature—F.C.D.] The magnetic minimum resting on daily measures, distinctly points to a date later than December, 1911. Of the eight comets of the year, three were under as constant observation as the weather would permit, sixteen photographs being taken of that of Brooks.

THE PARTIAL SOLAR ECLIPSE, APRIL 17th, 1912.

By E. W. BARLOW, F.R.A.S.

THIS phenomenon was observed at Bournemouth, where the extent of obscuration was between 91½ per cent. and 92 per cent., under excellent conditions, the sky being throughout absolutely cloudless and the definition good.

I obtained with my usual arrangement (4⅜-inch refracting telescope with camera and yellow colour filters affixed) a fine series of twenty-four negatives of all phases of the eclipse. The accompanying one was taken at 12·5 p.m. Greenwich time. I do not know exactly when the maximum obscuration occurred here, but this photograph was secured at not more than two minutes' interval of time from mid-eclipse.



From a photograph *by E. W. Barlow, F.R.A.S.*

FIGURE 229. Solar Eclipse. Greatest phase, 12.5 p.m.

It is enlarged, the original image being about 2¼ inches in diameter.

The solar disc was absolutely free from markings of any kind, spots or faculae.

The irregularity of the lunar limb is well shown; there are two distinct peaks visible on this (and several other of the negatives) about one-third of the way round the arc of the lunar limb from the right hand (west) side.

The diminution of the sun's light was very marked indeed and the eclipse proved a noteworthy spectacle. Indoors at mid-eclipse a heavy gloom like that of a thunderstorm pervaded. Outside the sunlight was very feeble and somewhat ruddy, the sky of a very deep leaden blue and all colours much toned down as if degraded with black. At 11.43 a.m., about twenty-five minutes before mid-eclipse, a small cumulus cloud which appeared on the N.W. horizon had a distinct coppery shade.

About eight minutes after mid-eclipse, on disconnecting the camera and substituting a Thorp polarising solar diagonal, I clearly perceived, for some considerable distance beyond each cusp, the portion of the lunar limb outside the sun's disc—in other words, the projection of the moon on the corona. This was also observed, to a less extent, with a three-inch refractor, ordinary solar diagonal and green cap, a few minutes later.

The temperature in the sun on the grass fell from 91°F. at the beginning to 55° at 12.14 p.m., about seven minutes after mid-eclipse, and rose to 90° by 1.30 p.m., the end of the eclipse—a drop of 36°. These observations were made with an ordinary thermometer, the bulb of which was surrounded by metal bars to hold it in place. The fall recorded is very nearly equal to that obtained with the

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blackened bulb thermometer at Greenwich. In the shade on the grass, a second thermometer stood at 52°F. at the beginning and end, and fell to 44° at 12.20 p.m.—a drop of 8°.

The very slight easterly wind, after veering to the south, dropped to a dead calm at mid-eclipse, again rising afterwards to its former strength.

Birds were unaffected by the phenomenon, singing loudly at noon as usual, but tulips in the sun, which were open prior to the eclipse, closed right up before the mid-eclipse and were again open by the end. Those in the shade were unaffected.

So far as the intervals between my photographs allowed, I kept a watch for other phenomena, shadow-bands, and so on, but nothing was seen. A white sheet was spread on the ground for this purpose.

SOLAR DISTURBANCES DURING MARCH, 1912.

By FRANK C. DENNETT.

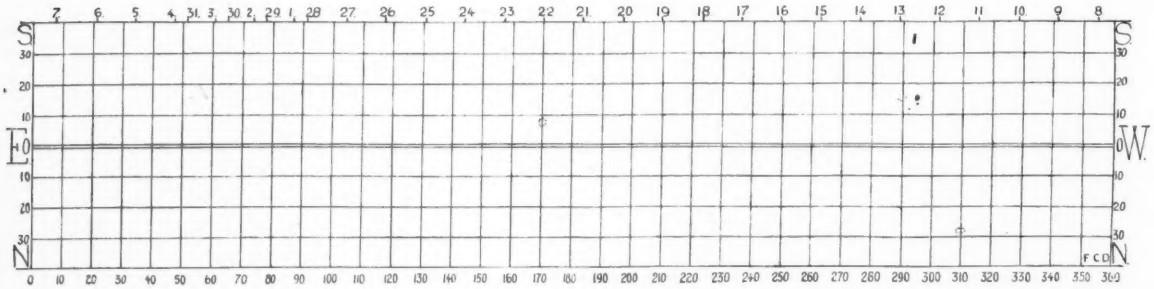
MARCH has a more interesting record than the two previous months. Only on twelve days has the disc been apparently quite free from disturbance, though on seven others only faculae were seen, but a spot group, the first this year, was visible on the remaining twelve. The longitude of the central meridian at noon on the 1st was 86°51′.

1.—A bright faculic disturbance within the eastern limb, on the morning of March 7th, was seen to contain a spot about fifteen thousand miles in diameter, with a bright photospheric arm penetrating a long way from its north-eastern border. In the afternoon this was found to be the leader of a considerable group. The group was very active presenting constant change. On the 11th, a pore easily seen at 9.30 a.m., could not be found a few minutes later. At 2.30 p.m. the spectroscope showed considerable activity present. The axis of the group showed a decreasing angle with relation to the solar equator as the group progressed across the disc, and on the 18th only the leader remained visible, much decreased, amid a faculic disturbance, the latter being still visible next day. On the 9th, 10th and 14th, the inner edge of the penumbra was noted as being brightly fringed. It will be noticed that this group is in the same position as the little group No. 41 in the record for December, 1911.

A faculic disturbance was recorded near the south-western limb, on March 3rd, and so near longitude 140°. On the 5th, a similar area was seen near the same limb, and therefore near longitude 95°. On the 6th and 7th, a faculic district in longitude 310°, N.-latitude 28°, was advancing from the north-eastern limb. On the 16th a small bright knot in longitude 180°, S.-latitude 66°, was noted. On the 18th, a faculic disturbance was seen nearly in the same longitude as the spot group, but much farther south. On the 22nd, a bright knot was within the eastern limb, near longitude 90°. On the 24th, a faculic district was nearing the north-western limb, and on the 27th and 28th, a small facula was near the western limb, longitude 170°, S.-latitude 7°. Two of these will be found marked on our chart.

The chart is constructed from the combined observations of Messrs. J. McHarg, A. A. Buss, E. E. Peacock, W. H. Izzard, and the writer.

DAY OF MARCH.



REVIEWS.

ARCHAEOLOGY.

The History of Fire-Making.—By EDWARD BIDWELL. 24 pages. 48 illustrations. 9-in. × 5¾-in.

(O. E. Janson & Son. Price 1/- net.)

That the interest and value of a publication are by no means proportional to its size is shown by Mr. Bidwell's little book. For very many years Mr. Bidwell has collected and studied the various methods of obtaining fire, and in 1910 he showed a representative series of specimens and illustrative pictures in the science section of the Anglo-Japanese Exhibition. So few, however, of the catalogues, containing a description of these, were available that many of those who would have highly valued the synopsis of Mr. Bidwell's researches were unable to secure a copy. Now the difficulty is removed, for Mr. Bidwell has reprinted the pages from the catalogue, with the addition of some illustrations made from his specimens for Mr. Miller Christy. The frictional methods which at the present time are practically confined to native races first come in for attention, then casts of an iron pyrites nodule and a flint flake found in a British barrow by Canon Greenwell, as well as photographs of two nodules of iron pyrites used instead of flint and steel in a tinder box in Suffolk until about 1827. Passing over flints, steels, sulphur-tipped matches, tinder and tinder boxes, we come to the fire piston, burning glass, and the electrophorus. The early chemical methods, which include the first matches and ways of getting fire before these were produced, complete the series and are possibly the most interesting, generally speaking.

Arrangements for bringing a sulphur match or a taper into contact with semi-oxydized phosphorus and then with the air are apparently the earliest and go back to the end of the eighteenth century. The details of Lorentz's electro-pneumatic lamp were taken from the Patent Office records of 1807, and in this, hydrogen gas was ignited by means of an electric spark. Pyrophorus was finely-divided carbon which ignited upon exposure to the air. The instantaneous light box was introduced into England in 1812. In this, chlorate of potash matches were brought into contact with asbestos soaked in sulphuric acid. Dobereiner's hydrogen lamp depended upon the fact that spongy platinum becomes incandescent when gas is allowed to impinge upon it and

lights the latter. The Promethian match, which was patented in 1828, contained a tube of sulphuric acid surrounded by a mixture of chlorate of potash and sugar. Walker, of Stockton-on-Tees, however, sold his first box of friction matches on April 7th, 1827. "Lucifers" were ignited by being drawn through folded sand paper. "Congreves," again, could be struck upon the box. Mr. Bidwell's catalogue describes a number of other forms which have played their part in the evolution of the match.

W. M. W.

ASTRONOMY.

The Science of the Stars.—By E. WALTER MAUNDER. 95 pages. $6\frac{1}{2}$-in.$\times 4\frac{1}{2}$-in.

(T. C. & E. C. Jack. Price 6d. net.)

The author is well known to readers of "KNOWLEDGE," and has compressed a surprising amount of information into the short compass of ninety pages. The early chapters give a short summary of the matter given more fully in the author's other books, "The Astronomy of the Bible" and "Astronomy without a Telescope." There follows a carefully written chapter on "The Law of Gravitation." "Astronomical Measurements," leads us up from the primitive obelisk and dial to the invention of the telescope, and a few of the results of exact astronomy. There is then a physical chapter discussing the telescopic appearance and probable condition of the orbs of the solar system. The final chapter deals with the system of the stars, their distance, number, brightness and motions. It may be safely said that a beginner who has mastered this little book has laid a sound foundation of astronomical knowledge, and is in a better position to tackle larger and more technical treatises. We notice one little slip *re* Halley's Comet on page 36. Halley is stated to have identified his comet with those of 1378 and 1301. Halley in reality erroneously identified it with the comets of 1380 and 1305; the correct identifications with those of 1378 and 1301 were made subsequently by Langier and Hind respectively.

A. C. D. C.

The A.B.C. Guide to Astronomy.—By MRS. H. PERIAM HAWKINS. 120 pages. $7\frac{1}{2}$-in.$\times 4\frac{3}{4}$-in.

(Simpkin, Marshall, Hamilton, Kent & Co. Price, paper covers, 1/6 net; cloth, 2/- net.)

This is a useful dictionary and glossary of astronomers and their work. The author's name has become familiar to us of late years from her attractive and handy little volumes.

It is difficult to avoid all inaccuracy in works covering so large a field as this; a few are noted in the hope that they may be corrected in a future edition, not as implying that the work as a whole is untrustworthy:—

Page 3.—Altazimuth: for "reversible transit circle," read, "transit circle that can be rotated about a vertical axis, so as to point in any direction."

Page 6.—M. E. M. Antoniadi is a *Greek* not a *Frenchman.*

Page 6.—Aquarids. The showers of May and July are given as both connected with Halley's Comet. Only the May one is connected with it.

Page 14.—Borelli should be Borrelly. He is French not Italian.

Page 24.—Dr. P. H. Cowell left Greenwich Observatory early in 1910, on his appointment as superintendent of *The Nautical Almanac.* Correction also needed page 68.

Page 52.—The great eruption of Krakatoa was in 1883; that of Mont Pelée (Martinique) in 1902.

Page 54.—The use of filar micrometers for stellar parallax is certainly older than the Lick Observatory.

Page 66.—It is the eccentricity of the Moon's orbit, far more than the evection, that causes the length of the "quarters" to differ. Also, their maximum range of difference is only one and a half days.

Page 67.—Moon's Variation. Instead of "The greatest impulse in speed is three days before Full Moon," read, "The greatest displacement due to the variation occurs three and a half days before each of the four quarters."

Page 76.—Professor Perrine has left Lick Observatory for Cordoba.

Page 91.—The date of photography of the spectrum of the reversing layer should be 1896 not 1876.

Page 102.—The Precession of the Equinoxes has nothing to do with the Sun's motion in space.

Page 108.—The comet of 1862, *not* Tuttle's Comet, is connected with the Perseid meteors.

Page 113.—Watson's minor planets were not found by photography.

A. C. D. C.

A Popular Introduction to Astronomy.—By REV. A. C. HENDERSON. 135 pages. 7 plates. $7\frac{1}{2}$-in.$\times 4\frac{3}{4}$-in.

(T. & J. Manson, Lerwick. Price 2/6 net.)

This is a chatty and discursive little work, dealing with a few selected questions rather than a systematic introduction to the whole science.

In the chapter on Biela's Comet it is stated that the comet itself collided with the Earth on November 27th, 1872; it would be more accurate to say the swarm of meteors associated with the comet encountered the Earth; the swarm must be much larger than the comet itself.

We notice some looseness in places in the explanations, thus a Total Eclipse of the Sun is said to take place when the Moon is in Perigee, implying that this is a necessary condition; it is in reality possible in summer for a Total Eclipse to occur when the Moon is at about its mean distance.

He seems hypercritical in objecting to phrases like "the Sun rises above the horizon"; they are perfectly legitimate if it be borne in mind that all our ideas of motion are relative.

Beginners in astronomy will, however, pick up a good deal of miscellaneous information from this book, including some points that are absent from the more conventional handbooks.

A. C. D. C.

The Great Star Map.—By PROFESSOR H. H. TURNER, D.Sc., F.R.S. 159 pages. 1 illustration. $7\frac{1}{2}$-in.$\times 5$-in.

(John Murray. Price 2/6 net.)

There is no one more competent than Professor Turner to write an account of the inception, progress, and partial completion of the Great Astrographic Star Chart. He took part in several of the conferences that have been held in Paris to settle the details of the work, and both at Greenwich and Oxford he has been most active in pushing on the taking of the plates and their subsequent reduction, for which he devised an elegant and simple method, which has been very widely adopted. He commences by tracing the history of photography as applied to astronomy, which now goes back more than half a century, and quotes an interesting letter of George Bond's, written in 1857, describing the successful photography of all naked-eye stars, and anticipating that future improvements might extend this to the eleventh magnitude—a daring prediction in those days, but now falling far short of the truth. The invention of the dry plate was a great step in advance; it was far more sensitive than the wet collodion plate, and permitted long exposures, whereas the latter ceased to be sensitive when dry. The number of stars shown on photographs of the great comet of 1882 came as a revelation of the possibilities of the new method, a hint which was quickly taken advantage of by Sir David Gill, Dr. Common, the brothers Henry and others. Finally, a great conference was held at Paris, under the leadership of Admiral Mouchez. There were advocates of three different forms of telescopes, reflectors, refractors and doublets. The reasons for the choice of the middle form are given; the whole sky was divided among eighteen observatories, all using refractors thirteen and a-half inches in aperture, with eleven and a-quarter feet focus ($1' = 1$mm.) Another interesting point touched on is the "reseau" of small squares on the plates, originally introduced to detect unequal shrinkage of the film, but retained as a great aid to measurement.

Star counting on the plates is next discussed, and the fact that the ratio of increase of number of stars per magnitude falls short of its theoretical value four. He inclines in the book to two explanations: (i) a solar cluster of our neighbours

among the stars, with a sparser region outside it; (ii) a certain amount of "fog" in space reducing the light of the more distant stars. This idea is strongly advocated in the book, though the author has subsequently receded somewhat from this position, considering that it indicates actual structural arrangement in the sidereal universe.

It is rather startling to find that we can actually test how the telescope was focussed by counting the numbers of stars in different regions on a large number of plates. It is usual to focus for a ring about midway between the centre and the edges, and if so, the star density on the plates is greatest in this ring.

The very practical detail of cost of taking and measuring the plates and publishing the results is dealt with, and the necessity for moderation in the number and accuracy of the measures is insisted on, if the completion of the project is not to be indefinitely delayed. Oxford and Greenwich have finished their portions, but many of the smaller observatories are a long way behind. As one of the main objects of the scheme is to complete the survey of the heavens in a reasonable time, and repeat it after a term of years, so as to find the proper motions of the stars, this delay, due to too ambitious ideals, is a serious matter.

Other interesting matters touched on are the Eros Campaign in 1900–01 for deducing the Sun's distance, and the discovery of Nova Geminorum, of 1903, on the Oxford plates. The whole book is written in a fluent and easy style, and should be read by all who desire to gain an insight into the great astrographic scheme, which is bound to loom very large when the history of the astronomy of our times comes to be written.

A. C. D. C.

BOTANY.

Plant Life on Land. — By F. O. BOWER, SC.D., F.R.S. 172 pages. 27 figures. 6½-in.×4¾-in.

(Cambridge University Press. Price 1/- net.)

The title of this little book is practically a paraphrase of that of Professor Bower's recent great work—"The Origin of a Land Flora." The author has, however, made no attempt at producing a summary of the latter, but has presented a series of separate essays, which at first sight may appear to be connected by a somewhat slender thread. Still, the connecting theme is readily traced, especially by readers familiar with the striking theories and generalisations with the exposition of which the author's name is associated. It is hardly necessary to say that everyone interested in plant life should read this little book, which is written in a most attractive style. For those who wish to go more deeply into the subject it will serve as an introduction to the study of the author's larger work, one of the most important contributions to botanical literature in recent years.

F. C.

Links with the Past in the Plant World.—By A. C. SEWARD, M.A., F.R.S. 142 pages. 20 figures. 6½-in.×4¾-in.

(Cambridge University Press. Price 1/- net.)

The author of this most readable and interesting book has hit upon a capital method of approaching the study of ancient plants from that of existing species, and deals largely with certain types and groups which have survived from early times to the present day. The first four chapters, on the longevity of trees, the geographical distribution of plants, the geological record, and the preservation of plants as fossils, are simply packed with information, while written in the author's usual lucid and scholarly style and therefore avoiding the least semblance of compression. Much of the matter contained in these chapters has been gleaned from sources outside the usual range of the botanical student's reading, giving a welcome freshness of treatment to familiar topics. The rest of the book is concerned with such present-day types and groups as have outstanding claims of long descent, and with their importance in relation to the great dominant groups in the vegetation of the remote past. We have but one fault to find with the last two chapters, dealing with the Araucariaceae and with *Ginkgo*, on which the author has done so much research work—these chapters are far too short. But then the same might be said of the book as a whole!

F. C.

Plant Life.—By E. WARMING; translated by M. M. REHLING and E. M. THOMAS. 244 pages. 249 figures. 7-in.×5-in.

(George Allen & Co. Price 4/6 net.)

The launching of still another elementary text-book of Botany upon the well-stocked market is an enterprise that requires some justification in these days, and this is especially the case when the book has been translated from a foreign language. However, there can be no doubt that many students and teachers will welcome Professor Warming's book, which has many admirable features and presents in many respects the excellent qualities which have made some of his larger works acceptable in various languages besides the original Danish. The present translation, however, might have been improved by a good deal of pruning and modification, in order to adapt it better to use in this country. It appears somewhat feeble to translate matter which is quite irrelevant so far as English readers are concerned, as, for instance, the three species of *Anemone* taken at the beginning of the chapter on classification, or the chapter on Danish plant-formations. True, the translator's notes indicate that these parts of the book are not applicable to this country, but it would have been much better to "naturalise" the book by incorporating suitable matter. However, a good many little points betray the lack of that thorough knowledge of the subject which would have enabled the translators to attempt this naturalisation process with success, so perhaps things are just as well as they are. There are some misprints, and Figure 243 is upside-down.

F. C.

Plant Physiology.—By B. M. DUGGAR, Ph.D. 516 pages. 144 figures. 7¾-in.×5½-in.

(Macmillan & Co. Price 7/- net.)

This handy manual contains an immense amount of carefully compiled and well-selected information, and is about the best of the smaller text-books of plant physiology that we have yet seen. Though specially adapted for the use of students of agriculture and horticulture, it is a book which the purely botanical student may use with decided advantage, while its direct and simple style of presenting the subject should attract an even wider circle of readers. A valuable feature of the book is the list of references to literature given at the end of each chapter, indicating the sources from which the latest and most detailed information on each topic may be obtained. As the author justly claims, a subject like plant physiology gains decidedly in interest when the illustrations are drawn largely from plants which are familiar and useful, and the relations of this science to plant production are kept in view throughout. The book is thoroughly up-to-date, as is shown by the treatment of such topics as balanced solutions, etherization, light-perception organs, and so on.

F. C.

The Forest Trees of Britain.—By the late Rev. C. A. JOHNS. Tenth edition, revised by G. S. BOULGER, F.L.S., F.G.S. 431 pages. 16 coloured plates and numerous other figures in the text. 8-in.×5½-in.

(Society for Promoting Christian Knowledge. Price 6/- net.)

Although this book was published originally in 1869, the editor of the present re-issue has thought it best to present the work very much as the author left it. The result is that, while a book like this cannot possibly challenge comparison with the many excellent works on British trees which have appeared in recent years, it is still eminently readable and interesting. Some of the old cuts are exceedingly poor and often quite unrecognisable, but some good photographic illustrations have been added in this reprint. This volume is a perfect mine of quaint and curious facts and fancies about trees, and forms an interesting supplement to more scientific works from which the sort of information compiled by Johns

is usually rigorously excluded. Johns' "Forest Trees" was in its day highly esteemed, as presenting the artistic and folk-lore aspects as well as the structural characters of trees, and it is for the former rather than the latter that it may still find a place in the literature of Botany. F. C.

Four Place Tables.—By E. V. HUNTINGTON. 33 pages. 9-in. × 7-in.

(Mass.: The Harvard Coöperative Society, Cambridge.)
(London: E. & F. N. Spon. Price 3/- net.)

A casual glance at the thirty-two pages of this book, followed by a reference to the price (sixty cents. in America, in London 3s. net.) induced a closer study with a view to discovering the cause of this comparative costliness. There are a good many distinctive merits in the book. First of all, by the arrangement of tabs on the margin, it is made easy to manipulate the book with the left hand and turn rapidly from one table to another. Next there is no table of anti-logarithms, which like tobacco and alcohol are luxuries and bad for the young. Then, in addition to the ordinary table of logarithms of numbers from 100 to 999, there is a special table from 1,000 to 1,999; and the same device for saving interpolation is adopted in the case of the logarithms of the trigonometrical functions for angles between 0° and 10° and between 80° and 90°. There are tables for conversion from minutes into decimals of a degree and vice versâ, also for squares and square roots, cubes and cube-roots, reciprocals, e^n and e^{-n}, Napierian logarithms and useful constants. The directions for use are clear and brief. Altogether the book deserves a trial. W. D. E.

Table of Logarithms and Anti-logarithms (Four figures).—By MAJOR HANNYNGTON, F.S.S., F.I.A. 41 pages. 8½-in. × 5½-in.

(Charles & Edwin Layton. Price 1/6- net.)

This small book of logarithms is intended for the computer. It should prove very handy and convenient, for it is very clearly arrranged and the printing is good. A. C. E.

Table of Logarithms and Anti-logarithms to five places of Decimals.—By E. ERSKINE SCOTT. 383 pages. 9-in. × 6-in.

(Charles & Edwin Layton. Price 5/- net.)

The publishers preface this volume of logarithms and anti-logarithms by a note stating that they hope the book may suit the requirements of students better than the more costly edition issued in 1892. The tables are clearly arranged, the first column containing numbers up to four places of decimals. The book is necessarily rather bulky, containing 383 pages, but its clearness makes up for this fault perhaps. The anti-logarithms are printed on green paper, which avoids chance of mistaking them for logarithms. A. C. E.

ORNITHOLOGY.

The Great Auk.—By THOMAS PARKIN, M.A., F.L.S., F.Z.S. 36 pages. 5 plates. 8½-in. × 5½-in.

(Hastings: Burfield & Pennells. Price 2/-.)

Mr. Thomas Parkin has been at very considerable pains to bring together the records of all the sales by public auction of the Great Auk and its eggs between the years 1806 and 1910. We find from his book that previous to the year 1869 the value of a Great Auk's egg ranged from twenty to thirty pounds. In 1869 the price had risen to sixty pounds, in 1880 to one hundred, and in 1888 to two hundred and twenty-five, while six years later three hundred and fifteen was reached, and in 1900 the record price was obtained, namely, three hundred and thirty pounds fifteen shillings. It will be seen on page 194 of this number that at a recent sale two eggs fetched only about half this sum, but as Mr. Stevens pointed out at the time they were not first-class specimens, and he had no doubt but that a really good one would still fetch a big price. It may be mentioned that with one exception (when a specimen was disposed of as part of a collection in 1908) all the Auk's eggs sold for more than twenty pounds have been knocked down at Stevens's. There are two instances, however, of outside sales where the buyers got two eggs for a song. The Kent sale is mentioned on page 194 of this number. Fourteen years previously (in 1880) Mr. Small picked up two eggs at Edinburgh for thirty-two shillings. For one of these Lord Lilford gave one hundred pounds and for the other, one hundred and seven pounds two shillings. Only five records of the sales of the bird itself are given by Mr. Parkin. The record price is three hundred and fifty pounds, obtained in 1895, while the last sold realised three hundred and fifteen pounds. The author learns from Mr. Edward Bidwell, who has made a special study of the subject, that there are now eighty skins in existence and seventy-three eggs.

The frontispiece to the pamphlet is from a photograph taken at Stevens's during the sale of an Auk's egg. Plate II is from a life-sized photograph of an egg in the possession of Mr. Parkin, Plate III shows another egg, Plate IV a stuffed specimen of the bird with an egg, and Plate V the London Museum, otherwise known as the Egyptian Hall, in which there used to be two eggs. One of these and a specimen of the bird were bought by Dr. Leach for the British Museum in 1819 for sixteen pounds fifteen shillings and sixpence, while the other egg only fetched between ten shillings and a pound. W. M. W.

PHYSICS.

Laboratory Problems in Physics.—By F. T. JONES and R. R. TATNALL. 81 pages. 67 illustrations. 7¾-in. × 5-in.

(Macmillan & Co. Price, 2/6.)

A useful laboratory manual, containing hints for practical work in Elementary Mechanics, Hydrostatics, Sound, Heat, Electricity and Magnetism, and Light, in the order given. A feature worthy of note is the prominence given to Revision questions and applications. The diagrams are clear, and teachers may gather some useful hints from them. In particular, a simple water-trap for "heat of vaporisation" has caught our eye. The order of subjects is, of course, largely a matter of individual taste: but the problems on Electricity and Magnetism are arranged in a sequence differing in many respects from that usually adopted in English schools. In many instances the experiments are expressly headed "Review Experiment," calling attention to the opinion expressed by the authors that a preliminary view of the subject (presumably in lecture) should precede the laboratory work in such cases. Many teachers of physics will probably agree with them. W. D. E.

Physicochemical Calculations.—By JOSEPH KNOX, D.Sc. 188 pages. 7½-in. × 5-in.

(Methuen & Co. Price 2/6.)

This book is based on Abegg and Sacken's; "Physikalisch-Chemische Rechen Auggaben," but it is not a mere translation, for the book is arranged carefully in subjects, and a short introduction to each chapter and new set of problems has been written. It should prove valuable to the teacher of physical chemistry as well as the student. A. C. E.

Waves and Ripples in Water, Air, and Aether.—Second issue. By J. A. FLEMING, F.R.S. 299 pages. 85 illustrations. 8-in. × 5-in.

(Society for Promoting Christian Knowledge. Price 2/6 net.)

Many of those who attended Professor Fleming's lectures at the Royal Institution on the above subject, wished that he would reproduce them in print; their popularity may be gauged by the fact that this is the second issue. Professor Fleming describes numerous experiments to illustrate in a manner intelligible to the majority of readers the most interesting phenomena of wave motion. Water waves and waves made by ships, sound waves, and electromagnetic waves, are examined and the results expounded in a delightfully clear manner. Just as Turner on being reproved for his idleness, when he spent a morning throwing stones into a pond, replied that he had not been idle, but had learnt how to paint a ripple, so no one who intelligently follows Professor Fleming through the pages of his book will have misspent his time. It is surely

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an added charm to know the intricate processes at work in the propagation of so beautiful a thing as a wave in the sea, but it is even more fascinating to learn to appreciate the unseen beauties which accompany a Hertzian wave.

A. C. E.

Soap Bubbles—Their Colour and the Forces which Mould them. (New edition).—By C. V. BOYS. F.R.S. 190 pages. 82 illustrations. 7-in.×4¾-in.

(Society for Promoting Christian Knowledge. Price 3/-.)

This book is also another edition of a series of popular lectures on a most entrancing subject, so popular that the distinguished author in his preface mentions that already "two tons of tiny bubbles are floating about the world." No one could help being fascinated by the appearance of a soap bubble, and if that fascination means anything it would give rise to a desire to learn more of the processes of nature which cause such beautiful phenomena. The book is full of experimental work on soap films of the most interesting nature, and it is not necessary to go further than to recommend it to everyone interested in scientific phenomena.

A. C. E.

BRIEF NOTICES OF BOOKS.

The list includes books which have been received since the last number of "KNOWLEDGE" went to press.

ASTRONOMY.

Annuaire Astronomique pour 1913.—By L'OBSERVATOIRE ROYAL DE BELGIQUE. 516 pages. 6 illustrations. 7½-in.×4½-in.

(Brussels: Hayez, Imprimeur de L'Observatoire Royal.)

We welcome the annual volume published by the Royal Observatory of Belgium, which has been issued without intermission since the year 1834. The meteorological observations were separated from it in 1901 and have since been published by themselves.

Catalogue of 9842 Stars.—By T. W. BACKHOUSE, F.R.A.S. 168 pages. 12½-in.×10-in.

(Sunderland: Hills & Co. Price 10/6.)

This catalogue of all the stars which are very conspicuous to the naked eye is applicable to the epoch of 1900, and it is intended to be used with fourteen large star maps. The preface of nearly twenty pages explains its construction and application.

BOTANY.

The Life of the Plant.—By C. A. TIMIRIAZEFF. 355 pages. 83 illustrations. 9½-in.×5¾-in.

(Longmans, Green & Co. Price 7/6 net.)

Miss Anna Chérémeteff has translated the seventh Russian edition of Professor Timiriazeff's book to form the volume under consideration. The various plant organs are considered in detail in special chapters prefaced by one dealing with special structure and another on the cell, while the plant again at the end of the book is compared with the animal, the origin of organic forms is discussed, and an appendix deals with the plant as a source of a supply of energy.

A Manual of Structural Botany.—By HENRY H. RUSBY. 248 pages. 599 illustrations. 9½-in.×6-in.

(J. & A. Churchill. Price 10/6 net.)

Dr. Henry Rusby is Professor of Materia Medica in the College of Pharmacy in the city of New York (Columbia University), and while his book claims to be a fairly complete introduction to Botany it has been written with special reference to the needs of a first year's student of Pharmacy.

CHEMISTRY.

Smoke—A Study of Town Air.—By JULIUS B. COHEN, Ph. D., B.Sc., F.R.S., and ARTHUR G. RUSTON, B.A., B.Sc. 88 pages. 35 illustrations. 9-in.×6-in.

(Edward Arnold. Price 5/- net.)

This small book deals with soot, its effects on vegetation, the gaseous impurities of air, town fog, and contains appendices on the influence of coal smoke on health and the soot fall of London.

GARDENS AND GARDENING.

Oxford Gardens.—By R. T. GÜNTHER, M.A. 280 pages. 33 illustrations. 7¾-in.×5¼-in.

(Parker & Son. Price 6/- net.)

Mr. Günther's work is based upon Daubeny's Popular Guide to the Physic Garden of Oxford, and has been brought out because neither the Guides written by Dr. Daubeny nor the Garden itself are as well known as they ought to be. During the greater part of the nineteenth century the garden was evidently unknown as a University Institution to the compilers of the University Calendar. Only within the last few years has it been included in the list of University Institutions, and this recognition has coincided with the residence of the Secretary of the delegates of the University Press in a house overlooking the Garden. Mr. Günther has added notes on the gardens of the colleges and on the University Park, as well as two good indexes.

Annuals, Hardy and Half-Hardy.—By CHARLES H. CURTIS. Edited by R. Hooper Pearson. 116 pages. 8 coloured plates. 8½-in.×6¼-in.

(T. C. & E. C. Jack. Price 1/6 net.)

The latest contribution to the excellent series of books entitled "Present-Day Gardening" is the volume on Annuals, Hardy and Half-Hardy. Its coloured illustrations are as usual by Mr. Ernest Waltham, who is greatly to be congratulated on the result of his work.

GEOLOGY.

Earth Features and their Meaning.—By WILLIAM HERBERT HOBBS. 506 pages. 493 figures, 24 plates. 8¾-in.×5¾-in.

(Macmillan & Co. Price 12/6.)

Professor Hobbs has prepared an expanded form of a course of illustrated lectures delivered in the University of Michigan. The subjects selected for study are those dominant geological processes which are best illustrated by features in North America and Europe. Professor Hobbs thinks that to combine in a single text book historical, dynamical and structural geology is to make the volume unnecessarily encyclopaedic and correspondingly uninteresting to the general reader.

METAPHYSICS.

A Mathematical Theory of Spirit.—By H. S. REDGROVE. 125 pages. 8-in.×5¼-in.

(William Rider & Son. Price 2/6 net.)

This book is an attempt to elucidate certain metaphysical problems by the aid of mathematics. The needs of the non-mathematical reader have, however, been constantly kept in view.

Is the Mind a Coherer?—By L. G. SARJANT. 304 pages. 7½-in.×5-in.

(George Allen & Co. Price 6/- net.)

Some extracts from the "Contents" of this book will give an idea of what it contains. Among the essays which take the place of chapters we find some with these headings, "Does Matter become Mind?"; "The Mind a Coherer"; "Non-

conversion of Matter to Mind"; "Food an Interest"; "Why do we not all think alike?" and "Law that defeats itself."

PHYSICS.

Studies in Terrestrial Magnetism.—By C. CHREE, M.A., F.R.S. 206 pages. 43 illustrations. 9-in.×6-in.

(Macmillan & Co. Price 5/- net.)

Dr. Chree's object in publishing his studies is to give a connected account of his own original work.

TOPOGRAPHY.

To the West of England by Canal.—By ROBERT J. FINCH, F.R.G.S. 63 pages. 16 illustrations. 7-in.×4½in.

(J. M. Dent & Sons. Price 9d.)

This small book is one of "The Educational Journey Series," and is concerned with the topography, scenery, geology, as well as the works of primitive and later man, along a line running from Reading to Bristol.

CORRESPONDENCE.

THUNDERSTORMS.

To the Editors of "KNOWLEDGE."

SIRS,—I see in a recent issue of "KNOWLEDGE" Mr. Tankerville-Chamberlayne remarks on the curious fact that one never hears of anyone who has observed a thunderstorm commence overhead. No doubt it does strike one as singular until you begin to calculate and see how often such a fact would be observed.

If we consider that any flash of lightning is more or less overhead which occurs in a circle of one-and-a-half or two miles diameter, and that thunder can be heard probably at least fifteen miles away, that is, in a circle of thirty miles diameter, we see that the ratio of storms beginning overhead to those not thus beginning is one to four hundred or one to two hundred and twenty-five, for the area of the large circle is from two hundred and twenty-five to four hundred times that of the small one. Taking an average of ten thunderstorms a year, we see that on an average only once in about thirty years would any individual experience the commencement of a storm overhead, and any one might easily forget an event happening so rarely. I see some authorities put down ten miles as the limit of audibility of thunder, but in this land of far distances, where you can see a storm playing over a kopje twenty miles distant, and can thus be sure of the distance of the thunder cloud, you will, I think, find that eighteen or twenty miles is not too far off to hear thunder. Under favourable circumstances I should not be surprised if I heard it even more than that.

CAPE TOWN. THEODORE B. BLATHWAYT.

PRIMITIVE CONSTELLATIONS.

To the Editors of "KNOWLEDGE."

SIRS,—A writer on the "Primitive Constellations" is responsible for this statement:—"The catalogued Tablets in the K collection of the British Museum alone number fourteen thousand two hundred and thirty, the far greater portion of which are astronomical. Most of these have yet to be examined." In the November part of "KNOWLEDGE" you have given us Professor Bickerton's confession, "Astronomy has become somewhat dry and arid. Official astronomers do not care for theories, for the linking silken cords of correlation," and so on. Now, I believe the astronomical knowledge of the Babylonians commands our highest respect, and it is quite possible that even in these enlightened days we may learn much from their imperishable records. Amidst the wrangle amongst scholars, is there not one that can clear up the mystery and speak with unquestionable authority on the *origin* of the old constellation figures and what they were meant to depict?

Are these figures pictorial representations of absurd Greek myths, or are we to go beyond the times of Greece?

Why should this branch of astronomy be left buried in the dust-heap of the ages? Perhaps some of your readers have gone deeply into these things, and could publish an article that would stimulate and guide others who are groping for light along these lines.

D. S. B. SQUIRE.

HOBSONVILLE,
AUCKLAND, N.Z.

NOTICES.

PHOTO-MICROGRAPHY.—We may remind our readers that Mr. E. Senior's course of practical demonstrations on Photo-micrography begins on May 6th, and will be continued on the five following Mondays, from 7.30–9.30, at the South-Western Polytechnic, Chelsea.

RESEARCH DEFENCE SOCIETY.—Sir David Gill, K.C.B., F.R.S., has succeeded Lord Cromer as President of the Research Defence Society, and Lord Cromer, the Right Hon. A. J. Balfour, Sir Edward Elgar, O.M., Mr. Rudyard Kipling, and Lord Rayleigh, O.M., have consented to be Vice-Presidents of the Society.

THE ROYAL INSTITUTION.—The following Lectures will be given on Friday evenings at 9 o'clock during May:—(3rd) "The Use of Pedigrees," by Mr. W. C. Dampier Whetham, F.R.S.; (10th) "The Gaumont Speaking Cinematograph Films," by Professor W. Stirling; (17th) "High Frequency Currents," by Mr. W. Duddell, F.R.S.; (31st) "Icebergs and their Location in Navigation," by Professor Howard T. Barnes, F.R.S., who will also deliver the Tyndall Lectures on "Ice Formation in Canada" on Thursdays (16th and 23rd), at 3 o'clock. On Tuesdays (14th and 21st) Professor Bateson, F.R.S., will lecture on "The Study of Genetics."

BEDROCK: THE NEW SCIENTIFIC QUARTERLY REVIEW.—The first number of this magazine has appeared and contains seven articles, all of which are worthy of most careful reading. Professor Welton's twenty pages show the position and usefulness of logic at the present day. As dealing with the interpretation of facts the writer points out that a complete employment of logical method may be the work of several minds, that the interpreter is not always the observer or not alone the observer, just as he frequently is not the only verifier, is never the only elaborator. Professor Welton agrees with Professor Turner's insistence (Address to the Mathematics and Physics Section at the British Association in 1911) on exact knowledge of facts and his warning against premature hypothesis, but Professor Welton urges that the idea that collected facts—or records of facts—"tell their own tale," may have, and often has had, disastrous consequences to science.

Mr. Archdall Reid devotes a good many pages of his paper on Recent Researches in Alcoholism to a discussion on natural selection as it affects mankind. He still emphasises his contention that a race must be drunk before it is sober, and that it is by natural selection weeding out those who cannot withstand diseases or succumb to the temptation of drugs, that we get comparative immunity in a race to a particular disease or a deleterious habit. Dr. Gossage in the last article, when discussing "Human Evidence of Evolution," offers other explanations. Professor Poulton has a good deal to say in praise of the way in which Bergson has put forward his theory of evolution as depending upon creative internal developmental force, but, nevertheless, in the two instances which are brought forward, namely, the nature of instinct and the growth of a mimetic resemblance, Professor Poulton shows without difficulty that the Darwinian interpretation can explain the results, whereas the Bergson solution breaks down entirely,

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and he urges from this that it is probable that the same thing would happen when the rival hypotheses are pitted against each other in any part of the field of evolution. The writing of the article has given Professor Poulton the opportunity of bringing forward some very interesting cases of mimicry where the male of one butterfly is mimicked by the female of another, and his article will appeal to everyone who is interested in Protective Coloration and Evolution generally. Professor Turner's contribution to the first number of *Bedrock* is substantially the Halley Lecture which he gave in 1911. Of a different character is Professor Gibson's consideration of "The Inter-action between Passing Ships." The Hermit of Prague in his remarks on "Social and Sexual Evolution," says that: "What humanity wants is such a social organisation as will allow every normal citizen to obey the two fundamental commandments that Nature has prescribed for all living things. These two commandments are (1) Thou shalt enjoy the fruits of the earth; (2) Thou shalt reproduce. But it is only when the society to which he belongs is so organised as to afford him a full assurance of his being able to obey the first, that *homo sapiens* can fearlessly obey the second."

The contents of *Bedrock* should arouse several interesting and important discussions, and we look forward with pleasure to the appearance of the next number.

WHO'S WHO IN SCIENCE.—This useful work, published for the first time this year, gives brief details of many men of science and a list of the senior professors in the universities of the World, as well as a classified index of the surnames (under the headings of each science) of workers in various countries. The new issue for 1913 will contain a section devoted to scientific societies, and as time goes on there is no doubt but that "Who's Who in Science" will become quite indispensable to all workers in science.

DEW PONDS.—In the April number of *The Journal of the Board of Agriculture*, Mr. Edward A. Martin, F.G.S., in the course of an article entitled "Ponds in Agricultural Districts" discusses the subject of Dew Ponds, to which he has paid much attention. He says that in the course of his experiments he has found no less than ten different methods of making a waterproof bottom. The principal constituent is puddled clay or chalk. He comes to the conclusion that there is no necessity for straw to be used in the process except as a temporary precaution against cracking during the making. A well-made puddled pond, he concludes, will outlast many cemented or concrete ones.

GANONG BOTANICAL APPARATUS.—We have on a previous occasion made mention of the apparatus designed by Professor Ganong for the use of his students. He has endeavoured to "develop such appliances, that is, tools, as shall fit their exact task, be applicable thereto with celerity and convenience, give quantitative results of minimal error and be obtainable at all times from the stock of a supply company." The Bausch and Lomb Optical Company, in whose hands the work of manufacture has been placed, have sent us their latest catalogue in which there are described in detail seventeen pieces of apparatus which will be found most useful in the study of plant physiology. These include a clinostat, by means of which a growing plant may be made to revolve in practically any position, as well as devices for demonstrating root pressure, respiration and transpirations.

YACHTING GLASSES.—Messrs. Ross have sent us a special list of British-made glasses, including a naval telescope and two binoculars, the "Night" glasses, which give the maximum illumination and field, and the "Naval Prism" binocular, magnifying six times and recommended because of its great stereoscopic power.

LENSES AND CAMERAS.—The same firm has issued its photographic list for the year 1912, which contains several new lenses and cameras, *e.g.*, the extra-rapid "Homocentric" lens, working at f 4·5. This lens is due to a development of the mathematical formulae of Gauss, which has been possible owing to the new kinds of glass available. The features which have been aimed at in the new "Telecentric" lens are critical definition with full aperture, and large image with short camera extension. A folding reflex camera has been introduced, and a junior "Multispeed" shutter, which is less expensive than the original one of that name, and is not intended for such extremely high speeds.

MONSTROSITIES AMONG MARINE FISH.—The Director of the Oceanographical Museum of Monaco, Dr. J. Richard, points out in *La Nature* for April 13th, that monstrosities are fairly common among certain fresh-water fish, and he gives a series of pictures of abnormal sea fish which are part of the collection of the museum under his charge.

PHILIPS' MONTHLY WEATHER CHART is a foolscap sheet of paper, ruled and headed, for the graphical representation of the daily observations of pressure, temperature, wind and rainfall, with, in addition, spaces for initials indicating the weather. For those observers who wish to set up their observations in the form of curves, this chart will be found convenient and useful. The price is one penny per sheet.

SECOND-HAND INSTRUMENTS.—As usual, Mr. C. Baker's catalogues of second-hand instruments and photographic apparatus should prove exceedingly useful. The first contains seventy-four pages dealing with microscopes, telescopes, surveying instruments, physical apparatus, and so on, while the other classified list, which is now published separately, runs to twenty-seven pages and gives details of second-hand cameras and lenses.

RAINFALL IN AUSTRALIA.—Mr. H. A. Hunt, the Government Meteorologist for Australia, has just issued the Rainfall Map for 1911. In that year about twenty-five per cent. of the total area of the Commonwealth had rainfall in excess of the average, and in Victoria the year was the wettest experienced since accurate observations began in 1850. The heavy rains, however, were not so widely spread as in 1910, when seventy-five per cent. of the total area had rainfall above the average.

Both in Australia and in Tasmania the excess rainfall in 1911 was experienced mainly in the eastern regions.

THE MISUSE OF LANTERN SLIDES.—*Science* for April 5th, 1912, publishes part of a paper read by Dr. C. H. Townsend at a meeting of Curators of Public Museums in New York. The title is "The Misuse of Lantern Illustrations by Museum Lecturers," but the remarks refer in a great measure to lecturers generally. A recent ornithological congress is described as a lantern-slide competition. Dr. Townsend is convinced that what we have come to call lecturing is not the real thing. It is a presentation to the eye, rather than to the mind, and the audience accepts it passively. He asks also, "Shall we continue to supply sugar-coated science until even the more discriminating part of the public begins to think that the professional ornithologist is really no better than the enthusiastic amateur who could photograph birds just as well"? The museums, however, are asked why they disregard the fact that the amateur's slides may be better than theirs. The question of written lectures is dealt with and various misguided efforts. In conclusion, Dr. Townsend suggests that we should illustrate our lectures and cease to lecture about our illustrations. The whole topic is one of considerable importance, and would form a good subject for discussion in the columns of "KNOWLEDGE."

THE CINEMATOGRAPH IN SCHOOLS.—As bearing on the subject of lantern slide exhibitions we may quote a paragraph from *The University Correspondent* for April 15th:—"Mr. A. P. Graves, ex-H.M.I., has been lecturing to the students of a Dublin training college on the use of cinematographs in school teaching and recent developments in that way. He suggested that educationists should 'domesticate the cinematograph, and make it a tame creature,' and said that Sir Ray Lankester has prophesied that within a year from now there will be machines of the kind at work in all the London Council schools."